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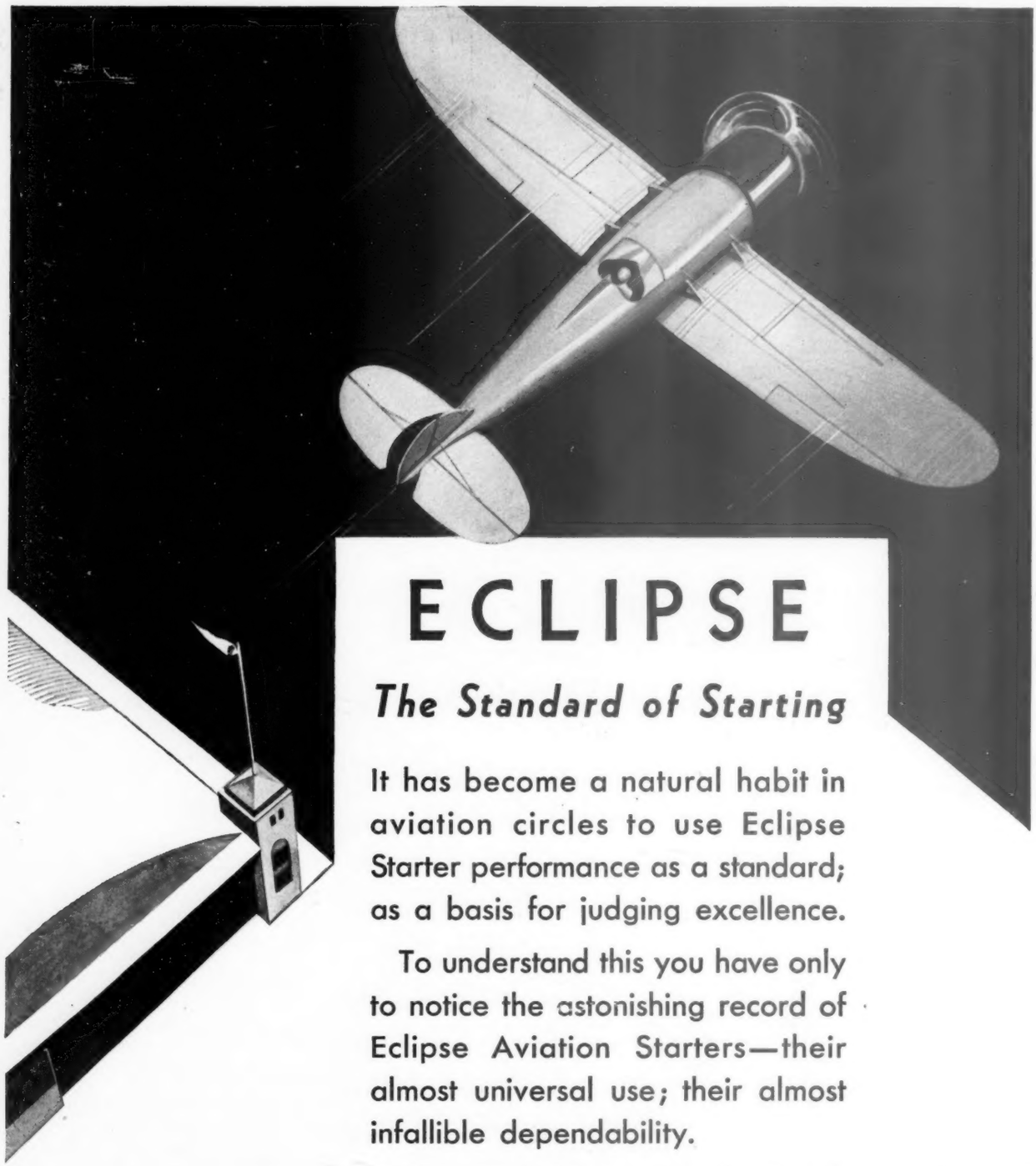

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AVIATION

A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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At right:—Fleet of Autogiros caught by the camera of Cy La Tour

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Army Air Corps

— HORACE C. KNERR, *President*
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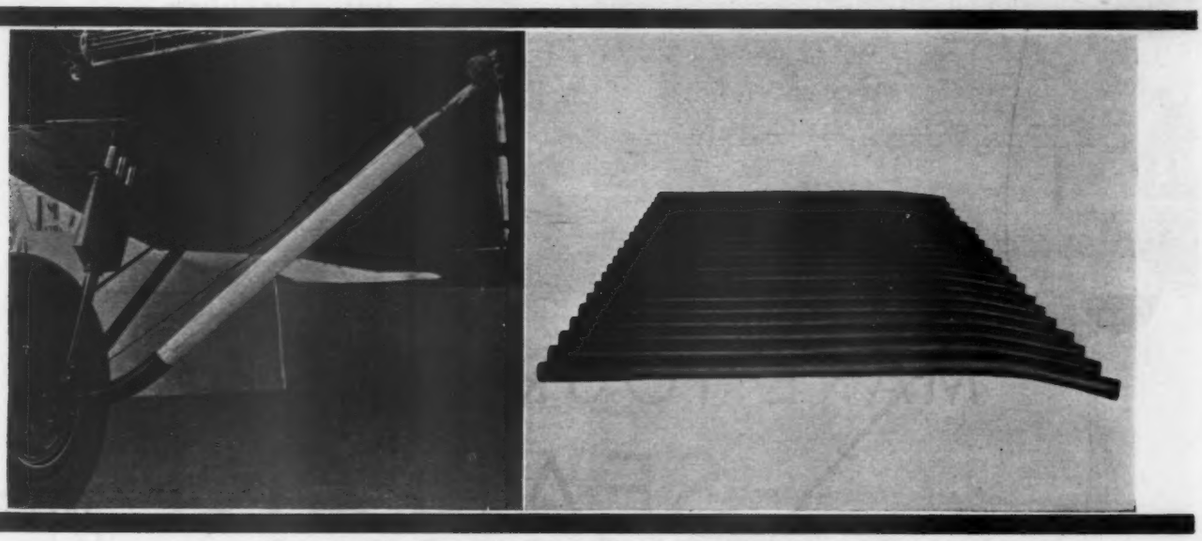

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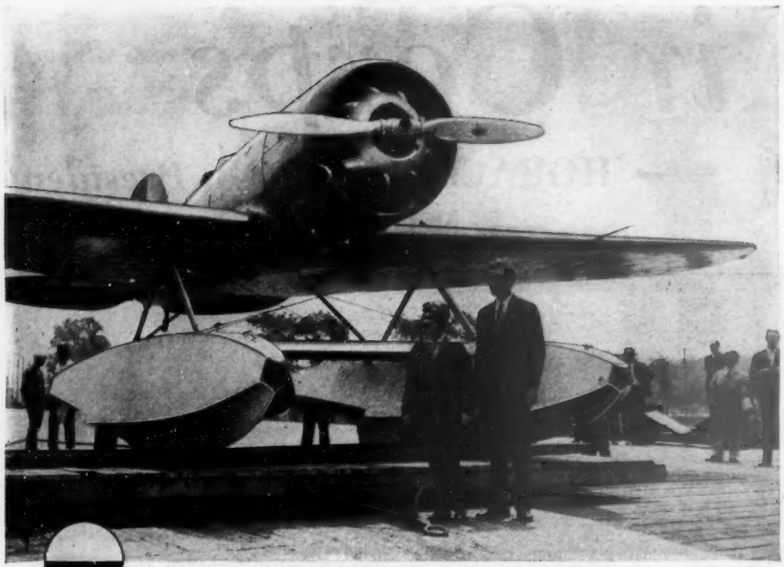

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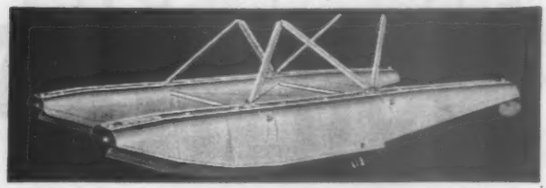

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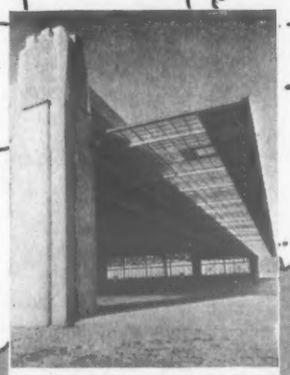

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AVIATION

A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

VOLUME 30 . . . *July, 1931* . . . NUMBER 7

Well done!

THE maneuvers went through according to schedule. The Air Force assembled in Dayton from the four corners of the country. It flew to Chicago, the Atlantic Coast, to Washington, and back to its several stations. It did all that in almost exact accordance with the schedule planned long in advance. Only in one instance was a flight postponed for a full day. The whole operation was accomplished without injury to officer or man sufficient to send them to the hospital, and less than 2 per cent of the total number of machines participating suffered enough damage to demand structural repairs or to force them to drop out of the line of battle.

The record is, we believe, unique. Never before have so many airplanes been brought together in peace. Never, so far as we can discover, has any unit or group of units done so much flying without at least one fatality. The performance reflects great credit on the American aircraft industry, and especially on the engines, both air and water-cooled. In 30,000 hours of flying the forced landings due to mechanical troubles can be counted on the fingers, and a substantial part of those that did occur were due to mistakes in handling the fuel controls or to other factors having no bearing on the design and construction of the power plant itself.

It would have been reasonable to hope, such is the admitted standard of reliability in present-day flying equipment, that 30,000 hours of flying might be completed without misadventure from any *materiel* cause. It would have taken a much bolder prophet to promise that no human error, among the 600-odd pilots and the 1,000-odd ground personnel participating, would have serious consequences. The perfect execution of the plans and the perfect freedom from tragic occurrence demanded an even higher standard from the personnel than from the machinery. It has never been our practice to engage in chauvinistic clamor about the qualities of American piloting personnel, whether in the services or in civil activities. We have always had the highest admiration for the personnel of the Royal Air Force, and for the pilots of the K.L.M., and for those of a variety of other European services and enterprises. On the strength of what happened between May 5 and June 5, however, with no other evidence produced, we are quite certain that the pilots of the Army Air Corps, (and the units of Naval aviation

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can be bracketed with it) are prepared and competent to challenge the world in any sort of mass display or in any test of average flying skill that may be suggested.

Praise to the pilots is obvious, and no newspaper has overlooked them. Praise to the equipment is only a little less obvious, but there is a third factor, at least as important as either of the others in its effect on certainty of performance and freedom from accident, that the casual spectators and their newspapers are quite likely to forget,—staff work.

Elsewhere in the present issue we have enlarged on some of the problems of organization and administration, and told how some of them were solved. Without going into detail here it is enough to recall what every man who is experienced either in military affairs or in the control of large business organizations will realize, that everything depended upon the preliminary planning by the staff in Washington, upon General Pratt's command in Dayton, and upon the commanding officer and his immediate supporters in the field. The record shows that they knew how much the men and the *material* were capable of standing. The spectacular results attained, and the vast scale of the movement, are evidence that they did not set their standard for their subordinates too low. The freedom from any untoward event is evidence that it was not set too high.

In judging of the capacities of the personnel, the men in command knew how far they could go largely because they were dealing with matters within their own experience. Within the past ten years, by no one's deliberate plan now and certainly by no one's fault in the past, but simply by the natural course of development, there has been steady change in the status of commanding personnel in the Army Air Corps. American students of British military aviation used to envy the Royal Air Force its possession of commanding officers who flew their own planes as a matter of course. Our own Air Corps was constrained by rapid expansion during the War and the rapid withdrawal of a large proportion of the temporarily commissioned officers immediately thereafter, to depend in considerable part upon high-ranking officers of great ability and of invaluable experience, but who were prevented by age, physical condition, or the constant pressure of their administrative duties from becoming fully qualified military pilots. With the passage of time we have outgrown all that. The Air Corps is in the hands of men who have grown up with it since the War or before, and a high order of piloting ability is taken for granted in the wearer of an Air Corps uniform, whether he has a gold bar or a gold star on his shoulder.

The supreme example of that development held the high command during the Great Aerial Trek of 1931. Benjamin D. Foulois was called to the head of the first air division with more than twenty years of active flying behind him. The record of the air division was in large part his record.

We make it an inflexible rule not to advocate or oppose in these pages the cause of any possible appointee to military command. No civilian outside of the War and Navy Departments has access to the full records of the men concerned in such a case, and none is competent to form a judgment. It is a scandalous thing that the attempt is often made to bring political or personal pressure to bear to control the assignments of military personnel. Nevertheless we proclaim in advance that we shall be more than pleased if the report, recently emanating from Washington, that General Foulois will be appointed chief of Air Corps upon the expiration of the present encumbent's term of office proves to be a correct one. We believe that there would be general satisfaction at such a decision. It would, we are sure, command enthusiastic approbation through all ranks of the Army Air Corps. And all other considerations aside, there would be a peculiar poetic fitness in the elevation of the Army's first aviator to the first position in the military hierarchy as the crowning event of his military career.

The evolution of miltary aviation into the hands of the men who fly need not have a simply military bearing. It sets a good example for the aircraft industry. It has often been the subject of remark that relatively few of the high executives of airplane companies, accessory manufacturing companies and air transport lines, either are or have been themselves pilots, even in the most modest way. Still fewer keep small private planes and make regular use of them. There are a good number who seldom fly even as passengers except as a means of getting from place to place, and who never think of going aloft with the test pilot to see for themselves what their company's latest product is like. It is every man's privilege to decide for himself how he can best spend his time and how he can best fit himself for the work he is doing, but we suggest that those who feel that their job in the industry has nothing to do with piloting should look carefully into the military example. We venture to predict that five years hence, or ten at the most, a non-flying president or sales manager of a company making commercial aircraft will be as strange an anomaly as a non-flying major in the Air Corps, or an automobile designer who has never driven a car, would be today.

To be

or not to be

HAMLET'S question is confronting many airline traffic managers as they wonder whether or not first-time passengers are to be repeat customers. Disquieting reports occasionally come in about unfavorable impressions given first-timers. Air-sickness, lack

of comfort, noise, and other factors have been prominently and unfavorably mentioned by occasional first-time passengers who have climbed out of their first airplane trip with a "Never again." The old theory that one ride would convert any earth-bound citizen into a confirmed aerial commuter has more exceptions than it should.

Fortunately, there is a reason for everything, and we may improve the reactions of first-timers by seeking and correcting in advance any possible reasons for adverse prejudice. The main job is not so much to sell the passenger upon the desirability of taking his first flight as to persuade him, while taking his first flight, of the desirability of coming back for more. Granting that we have done everything possible to impress him with our orderly operation and perfect schedules, there seems little opportunity to do much actual selling while the plane is in flight, with engines roaring mightily.

There is just one channel of attack,—through the medium of the written word. By providing him with appropriately prepared reading matter we may win the day. First we should remind him that if the plane rolls a little, or drops in and out of "air pockets" it is a normal occurrence and nothing to be alarmed about. We should explain that air-sickness is rare, considerably rarer than seasickness. That if air-sickness does occur once it will not necessarily repeat as the passenger gets accustomed to the air. Some lines try to supply that sort of soothing information now. Some do it very well. Others, seeking the same result, do it not so well, or definitely badly. Still others, unfortunately, do not even make an attempt.

After our attractively prepared pamphlet has treated the more immediate matters which are likely to be uppermost in the minds of the novice passengers, we can go on to the treatment of some even more vital subjects. A history of the record of the particular airline over which he is flying; an outline of the government requirements for transport pilots and for airplane construction; an account of the ground organization and of the way in which radio is used; a sound treatment of all these subjects in an attractive little folder which the passenger is invited to keep as a souvenir will do much to place him in the right frame of mind for another trip. It will be noted that we do not advise flooding the passenger with information about the technical details of airplanes and engines. Upon that point we are in full sympathy with Captain Courtney, who speaks his mind elsewhere in this issue.

It is perfectly possible to post pictures prominently around the walls of most of our present-day airliners. These should be illustrative of the same sort of subject that the pamphlet covers, and also of notable flights made by planes of transport type. Such pictures, with appropriate titles, do much both to give added confidence and to distract attention from noise or other unpleasant features.

A record crosses the Atlantic

THE DIESEL engine took its first step towards acceptance as a power plant for heavier-than-air craft when, in the summer of 1928, a diesel-powered machine first flew. The second step was made at the 1930 Detroit show, when the engine went on commercial sale. The third was accomplished last month, when a plane with a compression-ignition engine using furnace oil as a fuel circled over the beaches around Jacksonville for 84 hours and inscribed its performance upon the books as a world's record,—the longest flight ever made without intermediate refueling.

With the passing of the refueling-duration excitement, and with the apparent decision to allow that record to stand permanently at its present level, trials for straight time in the air without replenishment of supplies begin to regain a proper degree of appreciation. No other record, unless it be some of those for speed with substantial dead loads, is of such importance as the non-stop distance and duration marks. No other has such bearing upon precisely those qualities of aerodynamic efficiency, fuel economy, and reliability of airplane and power-plant that most affect commercial usefulness. It is more than three years since the duration record left American shores, and it has been more than doubled in that time. Its return is very welcome.

It is doubly welcome for being made with a fundamentally new type of engine. The diesel principle is not a commercial monopoly. It is open to anyone. Already two different designs in America, and one or two in Europe, have been in the air. For certain purposes, at least, it seems reasonable to expect that its special advantages will bring it into widespread use. Every practical demonstration of the progress of the diesel toward realizing its theoretical possibilities in the air as it has realized them on land and at sea is a bit of progress toward better and more economical commercial flying, and so benefits the whole industry. The fourth, and next, main element in the demonstration will be provided when diesels go into regular service on some well-known transport line as standard equipment, and the accumulation of data on performance under normal service conditions begins. We believe that that will happen before the end of 1932.

Many men, from Dr. Rudolf Diesel to Walter Lees and Frederic Brossy, have had direct or indirect hands in the making of this record. The greatest of all contributions was that of Lionel M. Woolson, who created the engine and flew with it in every test and brought it through its early troubles to the point of readiness for the commercial market. The flight that lasted four days and three nights is his memorial, quite as much as is the bronze plaque unveiled last April in the Detroit show hangar.

What's in *Aviation* . . . and why

THE aviation industry has undergone great changes in the last year, and we have modified our own form and content to keep pace. Careful analysis, backed by fifteen years of experience in aeronautical publishing, has led us to a succession of innovations. They have been introduced gradually, with no preliminary trumpeting. With this issue, which marks the completion of a year since the decision was taken to change from weekly to monthly publication, it seems appropriate to talk the content of the paper over with the readers.

A year ago we were printing 60 pages of news a month. We were carefully following and reporting in full, even the most minor events of the day. In the mass of weekly trivia, among a hundred items of fleeting and local importance or none at all, the occurrence of real and permanent significance was in danger of being overlooked entirely by the reader.

We tried to find out how much all that really meant to the industry, and to the people who are making for themselves rising positions in the aeronautical world. We went to some pains to inquire how many of them really wanted an indiscriminate accounting of everything that happened, large or small,—and as a result of our examination we began to present the news in an entirely new form, designed to fit more closely the desires of the great body of our readers.

We proceed today upon the theory that there are a very limited number of aeronautical happenings that are of lasting significance,—that have a fundamental effect on the present or prospective place of aviation in the community,—happenings about which everyone who has any interest in any phase of aeronautical activity ought to be informed. We undertake to winnow out such events from among the great body of material that reaches us,—to set them in logical order, bringing together those that are related or that react upon each other,—to point out the trends that the news dispatches indicate,—and to supply any historical background or collateral information that will be useful to the reader. We set the results up in each issue, immediately following the editorial pages, as a coherent running story of the news of the month. The man who will devote half an hour each month to reading that department will, unless we are grievously failing in our self-imposed task, emerge from it with a clear idea of where aviation is going and how. By deliberate choice we have substituted this novelty in news sections for the pursuit and presentation of innumerable disconnected items, for we believe the new form far more digestible, and far more useful, than the old.

Statistics form an integral part of the news, but a highly specialized part, and statistics alone can offer a very complete record of progress. There are some charts, like that of the rate at which student permits are being issued, that ought to be watched at every move by everyone in the business. There are others, like that of the number of airports in service, for which revision every four or six months is quite enough. Still others become important at irregular and unpredictable intervals.

To give them all their due, we set aside each month two pages adjacent to the news section. A few items, those which no sales manager or general executive can neglect in forecasting his own company's future and making its plans, are repeated each month. Aside from that, there is no standardization except a standard purpose to collect the current figures that are of greatest importance to the American industry, to present them in such fashion, by graph or table, that their vital points can be grasped at a glance, and to supplement them with brief analyses and explanatory comments. The type of information that is contained in those pages, together with more far-reaching compilation such as the annual statistical issue brings together, seems to us essential to the industry and to every intelligent leader of its operations.

In general, we don't believe in trying to segregate knowledge into departments. AVIATION is covering the whole field of design, construction, and operation. However, although the various groups within the industry have a communal interest in all aerial progress they also have specialized problems belonging only to their own parts of the field. Hence the group of departments that follow after the feature articles each month.

To the service manager or maintenance superintendent and to the mechanic we specifically address the Servicing Short Cuts. Through that page we give them the opportunity to exchange ideas, methods, and new designs for tools and fixtures with their fellows in other shops.

Airport operators have their own section, conceived in exactly the same spirit, as an experience exchange. Once a year a national airport conference brings the operators together, to discuss not only great questions of legal status and financing but also the little schemes that have been developed to attract a larger patronage and to handle the visitors after they arrive. Once a month, the Airport Management section of AVIATION appears with the same purpose.

The success of the operator of miscellaneous aerial service depends very largely on his success in introducing new ideas for using aircraft and persuading the people of his community to adopt them. A new idea developed by some other operator in a distant city is just as good as a wholly original one, and every report of such a novelty is a potential opportunity for new profit. The department entitled Aircraft at Work exists for the sole purpose of bringing such reports.

Merchandising and design, too, are something more than the application of general theories. They depend quite as largely on the solution of particular problems of detail. Hence, the Salesman's Notebook and Design Novelties.

News of the Month

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The month's grist of records

After two previous attempts thwarted by weather and a broken oil line, a Packard diesel-powered Bellanca plane, flown by Walter Lees and Frederic A. Brossy, established a new world non-refueling endurance flying record, exceeding the record made by two French pilots, Boussoutrot and Rossi, by 9 hr. and 10 min. The plane, whose engine had already flown 14,000 mi., was in the air 84 hr. and 33 min. over Jacksonville, Fla., and the surrounding country. The duration record, three years resident in Europe, thus returns to the United States.

New seaplane records for distance and duration were established in a flight by the French pilots, Lieutenants Paris and Gonard, over a circuit of 115 mi. near Arcachon, France. They flew their six and one-half ton plane for 36 hr., 48 min., and 44 sec., and covered a distance of 3,230 mi. It is not yet known what dead load the plane carried on the flight, but it does not appear that the absolute duration record for seaplanes without dead load is officially broken, as the present record (held in America) is 36 hr. 1 min., and the F.A.I. rules require that previous records be exceeded by at least an hour. The existing seaplane distance record, also American is 1,569 mi., and has now been beaten by a good margin.

Another attack on records now held in France is contemplated by the British Air Ministry. Reconstruction, by the Fairey Aviation Company, of the plane in which two pilots were killed last year when they struck a mountain while flying blind, is under way. When completed, this monoplane, with a 90-ft. span and a fuel capacity of more than 1,000 gal., will try for the long-distance flying record now held by Coste and Bellonte for their non-stop flight of 4,912 mi. from Paris to China. The previous attempt, fatally terminated, was for a non-stop flight from England to Cape Town (about 6,000 mi.) while a still earlier British effort had made a record non-stop trip from England to India.

Capt. Frank M. Hawks has spent the last month upsetting European ideas of airplane speed by splitting records which have previously stood for the fastest air transportation. From London to Berlin in 2 hr. 57 min. was better time than a telegram dispatched at his departure could make. The next day he set a 45-min. mark for the flight between Berlin and Hamburg. A week later Captain Hawks ate his way around Europe. Rising in Paris he flew to London for breakfast, thence to Berlin for luncheon and back to Paris in time for dinner, after 7 hr. and 31 min. in the air.

Linking the continents

A new record for the flight from England to Australia and return has just been established by Charles W. A. Scott, who bettered Wing Commander Charles Kingsford-Smith's time in each direction, clipping 48 hr. from the former record for the return trip. His time from Wyndham, West Australia, to Lympne was made in 11 days, on most of which he encountered monsoons or strong headwinds. The outward trip was made in 9 days and 3 hr.

In contradiction of rumors that engine trouble would necessitate its return to Germany, the Do.X finally took off on June 4, from Porto Praia, Cape Verde Islands, and flew to Fernando Noronha, about 200 mi. off the coast of Brazil, in 12 hr. and 26 min., averaging about 100 m.p.h. for the trip. The following day the remaining distance was covered to Natal, on the Brazilian mainland, where the plane stopped long enough to be overhauled for its projected trip down the coast to Rio de Janeiro and Pernambuco.

Prepare for blue ribbon races

Italy's participation in the Schneider Trophy Contest continues to be an uncertainty. General Balbo, in his recent speech before the Chamber, prepared the Italian public for the possibility of a withdrawal in case planes with a good chance of victory are not completed at a sufficiently early date. In this connection he mentioned that pursuit planes with a speed of from 220 to 250 m.p.h. will soon be in regular use in the Italian air forces.

An aerial race around Britain for the King's Cup will this year, for the first time, have a Canadian contestant. The race is open only to amateurs flying privately owned planes. The machine is to be a Curtiss-Reid Rambler, designed and built in Canada.

Air tour plans mature

Early in June, and just after Manager Ray Collins had completed the customary pathfinding trip, and with the start of the Seventh Annual National Air Tour on July 4 less than a month away, it was announced that because of prevailing bad weather in Mexico during July the itinerary had been changed to include only United States and Canadian cities. A number of changes have been made to fill out the program.

The revised route is: Walkerville, Ont.; Binghamton, N. Y.; Watertown, N. Y.; Bradford, Pa.; Pittsburgh; Wheeling; Columbus; Huntington, W. Va.; Evansville; Nashville; Memphis; Birmingham; Gulfport, Miss.; New Orleans; Shreveport; Houston; Corpus Christi; San Antonio; Fort Worth; Wichita Falls, Texas; Oklahoma City; Ponca City; Chanute, Kan.; Kansas City, Mo.; St. Joseph, Mo.; Lincoln, Neb.; Sioux City; Davenport, Iowa; Peoria; Fort Wayne; Akron; Kalamazoo and Detroit.

Twelve machines had been entered by June 10—three Buhls, two Fords, two Birds and a Curtiss-Wright entry.

Another national air tour was being

Calendar

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June 27	Twelfth Annual Royal Air Force Display, Hendon
June 29-30	Fourth National Airplane Model League of America Contests, Dayton.
July 1-Sept. 8	Trans-Canada Air Pageant.
July 4-25	Seventh National Air Tour.
July 10-19	Second Annual Air Tour of Italy, for light planes.
July 25	King's Cup Air Race, England.
Aug. 2-16	Second Annual National Soaring Meet, Elmira, N. Y.
Aug. 29-Sept. 7	National Air Races, Cleveland Municipal Airport.
Sept. 1-3	Twentieth National Aeronautical Meeting, S.A.E., Hotel Statler, Cleveland.
Sept. 11-13	Third Annual Air Races, Sioux Falls, S. D.
Sept. 12	Schneider Trophy Contest over Solent and Spithead.
Sept. 12-13	International Air Fete, Los Angeles.

rounded into shape during June. The trans-Canada Air Pageant, sponsored by the Canadian Flying Clubs Association, is to start from Hamilton, Ont., Dominion Day, July 1, and in the course of the next twelve weeks cover Canada from coast to coast. It has been organized for demonstration of aeronautical equipment and for promoting the general interest in aviation in Canada, and is to be entirely non-competitive. The Royal Canadian Air Force and many commercial and club interests are likely to be represented by planes in the event.

The annual tour of France for sport planes was held April 25 to May 10. Thirty-nine of the 52 starters covered the course, which started and ended at Orly. Flying was done as a rule every other day, the intervening days being devoted to demonstrations of machines and social activities. A speed contest on the last day was the only element of competition.

Cup won, convention planned

The D. C. Air Legion, of Washington, has received a trophy as the outstanding private flying club in the country. The trophy, presented through the American Society for the Promotion of Aviation to President J. Elmer Kreis, was earned by the past year's record of 108 new members, 52 soloed, 2,500 hours flown and four planes purchased out of income.

Washington is to be the scene of the annual convention of the National Aeronautic Association on July 23 and 24 this year. The executive committee, of which Porter Adams is chairman, was unanimous in its selection of the Capitol as meeting place. In every previous year except 1927, when the races were in Spokane and the convention in St. Joseph, Mo., the convention and National Air Races have been held together.

Bad news for Canadian air mail

Canadian aviation was shaken to its foundations late in May when the government announced that for budgetary reasons elimination of certain air mail contracts and revisions of others had become imperative. First interpretations of the announcement were that practically all air mail services would be cancelled, or reduced to practically complete effacement. The government later called these reports misunderstandings and announced that negotiations with operators of the larger and more important groups are still in process.

In the light of latest information, it appears that the Canadian government is about to readjust its air mail agreements, even as the United States Post Office Department readjusted its contracts with the domestic air mail carriers a year ago and again in March. Canada's reasons may differ and the action may be more drastic, but the general intent seems to be similar.

Air mail service to the most outlying communities—such as Aklavik, on the Arctic Circle, other Yukon points, and the Magdalen Islands in the Gulf of St. Lawrence—will be continued in any case. It is probable, too, that the United States-Canada contracts will be fulfilled. Three of the smaller lines have been cancelled already.

Because of the long distances involved and the widely scattered communities, air mail in Canada has been considered of particular value and of much promise. Canadian and American air mail have much in common and the fortunes of one are somewhat reflected by the other; there are three connecting links between the two countries via Canadian Colonial (New York-Montreal) Northwest Airways (Twin Cities-Winnipeg) and Gorst Air Transport (Seattle-Victoria).

The Montreal-Rimouski service has materially speeded up trans-Atlantic mail between England and Canada. Two planes met the new Empress of Britain at the rendezvous point on her first voyage and enabled mail to reach Montreal 5 days 8 hr. 10 min. from Southampton.

American mail services happier

Expense of American air mail has been much discussed in government circles in connection with the Presidential campaign for new economies to meet the new deficit. It is officially announced that the air mail service (domestic and foreign combined) last year cost the Post Office $20,015,969 over and above the income received. Mail operators earned $5,761,151 in passenger and express traffic in addition to mail revenue last year.

Despite deficits, American air mail services are being extended. On June 1 Northwest Airways began operating mail and passenger service between Fargo and Bismarck, N. D.—an extension of the company's regular operation—and daily service was extended also from Twin Cities to Duluth.

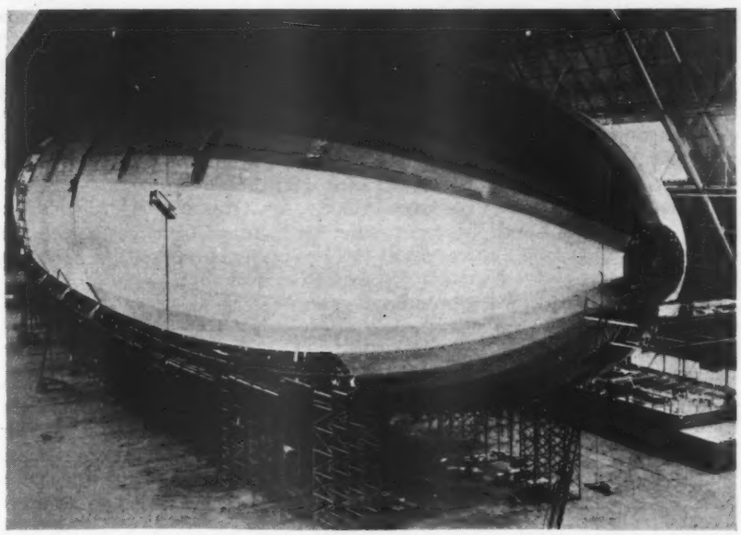
On June 8, Pennsylvania Air Lines, Inc., began tri-daily mail and passenger service between Washington and Pittsburgh. On June 15, American Airways began operating two extensions, or tributaries, of its Atlanta-Los Angeles run. These are the Nashville-Fort Worth route, by way of Memphis, Little Rock, Texarkana and Dallas, and a Memphis-Jackson-New Orleans service. As a result of the latter contract, Robertson Airlines, which has been operating a passenger service between St. Louis and New Orleans by way of Memphis April 27, 1930, suspended operations. A number of its pilots and officials have joined the American Airways staff.

While no formal protest has been filed at the time this is written, there were indications in Washington that the award of these extensions to American Airways may arouse some opposition. The Comptroller General's office is yet to be heard from.

In a similar instance the Comptroller General held that the act of Congress

OVER EIGHTY-FOUR HOURS

The plane, the engine and the crew, which brought back to this country the world non-refueling endurance record. Walter Lees (left) Packard chief test pilot, and Frederic Brossy, also a Packard test pilot, standing before the Bellanca Pacemaker. The engine is the Packard Diesel of 225 hp. The plane has a 54½-ft. wing, specially designed for this machine.



NEARING COMPLETION AT AKRON

Covering of the Navy's new airship is proceeding rapidly, and the first test flight is scheduled for some time in July.

permitting the extension of an air mail route does not allow an entirely new route to be established as an extension of an existing contract. In that case (extension of the Northwest Airways route between Chicago and Minneapolis to Omaha), Comptroller General ruled that a line running between Omaha and Winnepeg did not constitute an extension, and the project was abandoned.

As a test of whether a proposed route may be regarded as the extension of another, the Comptroller General attaches prime importance to the interchange of mail that may be effected. Critics of the new award maintain that the bulk of mail flying north from New Orleans will not be transferred at Jackson to planes on the trans-continental route, but will continue on to such centers as Chicago, Cleveland, and St. Louis.

Cities combat choice of Charleston

Air mail interests, particularly Pan-American and American Airways, are waiting the Post Office Department's revised request for bids on the United States-Bermuda section of the proposed trans-Atlantic air mail service. In the meantime, New York and Baltimore have been combating the designation of Charleston, S. C., as the hop-off point. The Post Office Department, however, seems to consider the matter as finally settled. Charleston is about 825 mi. from Bermuda, Baltimore is about the same distance, and New York City 35 mi. nearer.

Representative Kelly of Pennsylvania, author of the first contract air mail bill, promises to introduce to the next session of Congress legislation providing for the use of air mail pick-up devices. The purpose is to amplify the feeder route idea by flying planes of small capacity and moderate speed along the main routes, picking up mail at intermediate points and delivering it to the larger and faster machines at regular stops.

Airline affairs in Europe and the Orient

The Indian government, as part of its program to handle directly the development of airlines in that country, has ordered four Avro Tens (essentially like the F.10 Fokker and built under Fokker license). The first line will run between Delhi and Calcutta and will connect with the Imperial Airways service at the former city.

This will amount practically to the addition of another link in Imperial Airways' long proposed London-Australia air mail service. Progress in rounding this out is extremely slow, but the second of two experimental round trip flights over the entire route was successfully completed recently, the flight back from Australia requiring twenty days.

Recent information from Europe indicates that reorganization and refinancing of Compagnie Generale Aeropostale are well under way and that in the meantime service in Africa and South America is being maintained through cooperation of the French government. The Associated Press reports that the 6,000-mi. Shanghai-Berlin air mail service was inaugurated May 31 by German pilots in Junkers planes.

That fire in the air may sometimes be a small matter, and that it may not even affect the nerves of the passengers, was demonstrated recently on an Eastern Air Transport plane en route from Washington to Newark. Defective insulation of a heater pipe at the point where it entered the fuselage started a fire in the cabin. While the co-pilot attacked it with an extinguisher the pilot made a landing in an emergency field. The next plane flying by on regular schedule picked up as many passengers as possible and brought them to Newark, the only persons suffering any inconvenience being those forced to find other means of transport to New York.

Express by air expanding

Air express services recently inaugurated expedite rush shipments in the United States and over its southern border. Through agreement between the Transamerican Airlines Corporation and the Western Union Telegraph Company seventeen mid-western cities now enjoy fast express service. Collection and delivery of shipments by Western Union messengers and their transportation by the planes of T.A.C. make it possible to send a package from downtown Cleveland to downtown Detroit in 55 minutes, and from Detroit to Chicago in two hours and a half.

Equally efficient service is available from the U. S. to seventeen of the South and Central American countries served by the Pan American Airways, through its connection with the Railway Express Agency in this country. Paring down customs demands to a single document, an "airwaybill," reduces the time necessary for merchandise shipments to one-half and even one-third that required by the fastest steamers.

New name, and new rates

The Boeing System has become United Air Lines. Boeing Air Transport, Pacific Air Transport, National Air Transport and Varney Airlines will retain their identity as operating units. Chicago replaces Seattle as executive headquarters of the lines. Using six Fords, P.A.T. started on May 28 a "Daylight Flyer" between Seattle and San Diego. The 1,206-mi. route is flown in 11 hr. 20 min. Planes leave San Diego at 7:30 a.m. and Seattle at 8 a.m.

A number of prominent lines have announced fare reductions. National Air Transport has cut its rates between New York and Kansas City (by way of Chicago) approximately 10 per cent, the fare being $82 instead of $90.16, approximately $0.07 per mile. Canadian Colonial Airways has lowered its rate to about $0.075 per mile. Pacific Air Transport reduced its rate 15 to 20 per cent in May, to a mean of about $0.068 per mile.

Transcontinental & Western Air also has made minor reductions, especially

for short haul passengers. The company's two Fokker F-32's were returned to regular service on the Los Angeles-San Francisco run in May. Wrigley interests have taken over the Catalina service formerly operated by Western Air Express.

Europe, also, has fare reductions. Imperial Airways has reduced one-way fares on all its services. The London-Cairo fare for example, is now $225 instead of $250, a rate of $.093 per mile. Similar reductions have been made on all its services.

Quarterly traffic reports are being announced. Pan American Airways carried 12,842 passengers in the first quarter of this year, 110 tons of mail and 52 tons of express and baggage. Every trip was completed on or ahead of schedule. Transamerican Airlines carried 2,135 passengers between Cleveland and Detroit, 752 between Chicago and Detroit.

And new services

Among the new services announced is the resumption on June 1 of New York-Atlantic City service by New York Airways, a subsidiary of the Aviation Corporation of the Americas. North Beach Airport again is the New York City terminal. The fare is $9.50. On July 1, the daily service will be stepped up to four round trips daily.

Ludington Line operates hourly to Atlantic City from Philadelphia. Service began June 13 with two new Stinson transports.

Century Airlines, which inaugurated frequent service in the Middle-West recently, was scheduled to open a Los Angeles-San Francisco hourly service June 22, using Stinson tri-engined transports. The fare was to be less than rail plus Pullman. St. Louis, Kansas City, Tulsa, Oklahoma City, Dallas and Fort Worth are to be linked in the same way by the same company. R. W. Cantwell, formerly chief pilot and assistant operations manager for Safeway airline, has been appointed assistant general manager in charge of the southwestern division of Century.

The interesting service operated last year between Rockland, North Haven, Stonington and Islesboro, Me., by William Wincipaw, then with the Curtiss-Wright Flying Service, has been resumed this year by Wincipaw and an associate operating as the Maine Air Transport Company. A Bellanca Pacemaker and a Waco on floats are used. These Penobscot Bay points are completely inaccessible by land and the airplane meets only the competition of small and slow-moving steamers.

Railroads display jealousy?

Increasingly direct and intense competition between airlines and railroads for traffic was forecast in May by Gilbert G. Budwig, director of air regulations, Department of Commerce. Following in the wake of his comments came the report from Chicago of hearings by the Illinois Commerce Commission of a petition by Century Airlines for a certificate of convenience and necessity to operate between Chicago and St. Louis. American Airways which also operates mail and passenger service between the same cities also sought the certificate.

At least three railroads were prominent in throwing doubt on safety of airlines in general and the adequacy of airports. The hearings were to be continued.

Then, too, the New York, New Haven and Hartford railroad has been seriously

INTO SPACE

Preparing for man's first penetration of the stratosphere, the Piccard balloon being inflated at Augsburg, Germany.

studying the question of meeting competition from Colonial Air Transport between New York and Boston by installing a service of its own, with refinements which coordination with railroad facilities would afford.

Marking regulations under fire

Early in June representatives of the Department of Commerce and of trade groups (such as the National Electric Light Association) interested in the problem of marking obstructions to flying discussed at Washington certain protests of the latter group regarding the present federal marking regulations.

The regulations, it was revealed, are being revised and will be issued as *recommended standards*, rather than as official regulations. Furthermore, the trade groups organized a permanent committee for the study of the marking problems and for the preparation of recommendations to the government. An outstanding question coming before it will be the means of determining who will pay for marking made in accordance with the government's suggestions. George W. Orr, of Roosevelt Field and the Aeronautical Chamber, is the industry's representative on the permanent executive committee.

Airway facilities added

The Department has announced completion of lighting the airway through the 51-mi. Columbia River Gorge. Electric code beacons are located at 21 points on both sides of the gorge, forming a lane through which pilots may fly. Green lights are on the Washington side and red on the Oregon side. Unusual difficulties were encountered in installing these lights, among them the arrangement for approximately 25 mi. of pole line extensions. Many of the poles had to be set in rock.

A sort of airway block signal system using red lights to signal scheduled transports flying on the New York-Washington airway, is being tested by the Ludington line. In case it becomes advisable to flag a plane down, red lights will be displayed and the pilot will be expected to return to the nearest landing field.

Port construction progresses

Reports to the Aeronautical Chamber of Commerce, covering airport construction projects under way during the Spring, indicate that $2,209,674 is being spent on new construction work. Municipal projects predominate.

Some of the ports and the amounts included in this total are: Oklahoma City Municipal Airport $580,900; Chicago Municipal Airport $426,556; Boston Municipal Airport $175,000; Fort Worth Municipal Airport $155,000; United Airport, Burbank, Cal., $155,000; San Francisco Bay Airdrome, $125,000; Denver Municipal Airport $88,700; Bates Field, Mobile, Ala., $79,500.

Construction has been started on the first element—a concrete retaining wall enclosing an area about one mile square—of the Shushan Municipal Airport on Lake Pontchartrain, New Orleans, La.

Washington-Hoover Airport Corporation is installing an outdoor swimming pool which will cost between $175,000 and $200,000, as additional bait for the general public. It will measure 90x200 ft. and will be surrounded by an artificial sand beach of 50,000 sq.ft. Handball courts adjoin.

Civic interests in Brooklyn, N. Y., have been discussing the possibility of constructing an airport just south of Governors Island on the site of Red

Hook Flats. It is suggested that a tract approximately 10,000x3,000 ft. could be made available. No action has been taken on the scheme.

Lighting of Mexico City Municipal Airport has been completed.

Slot patents valid

A case in litigation since the Guggenheim safe aircraft competition has finally been settled out of court with the entry of a consent decree. The question was the infringement of Handley-Page patents in the Curtiss Tanager, winner of the competition. The validity of the slot patents has been recognized and the Curtiss company has taken out a licensing agreement to enable them to make use of the slotted wing on their machines, if and when desired, on the usual royalty basis. An Italian firm has also negotiated an agreement for the use of this safety device, paying a substantial sum for the privilege.

Legislation proposed last year by the War Department and warmly supported within the industry, to authorize the Army Air Corps to conduct tests of civil aircraft and equipment has been vigorously opposed by the American Engineering Council. The council, representing the great national engineering societies, expressed disapproval of a system which would permit a government agency to compete with private enterprise and suggests that the bill be amended to authorize the Army to conduct only those tests for which no facilities exist elsewhere. The original purpose of the bill was to give commercial industry access, at reasonable charges, to such specialized equipment as the propeller whirling rig at Wright Field.

An intensive program of experimentation and research is under way in the American Navy. The world's largest non-rigid airship, designed to perfect the use of a fuel gas of the same density as air, as in the Graf Zeppelin, is ready to be assembled. Its envelope will be sufficient to contain 320,000 cu.ft. of lift gas as well as special insulated cells for the fuel gas which can be replaced by air as it is consumed. The fact that water-recovery apparatus can be dispensed with in an airship using fuel gas, and the cruising radius and loads carried be increased with only slight modifications in design, make this experiment of prime importance. Also, a special appropriation of $225,000 makes possible additional experimental work to develop greater speed in naval aircraft and to develop engines of power comparable to the 1,000-hp. plants now being built in several foreign countries. This forecasts an American entry for the Schneider Trophy in 1933 unless a British victory this year removes it from competition.

Three interesting experiments

Catapult launching is a regular feature of ship-to-shore mail service and an old story in the Navy, but an apparatus to hurl an eight-ton twin-engined bomber into the air in three seconds after a run of only 100 ft. is another matter. Royal Aeronautical Establishment at Farnsborough has developed such a machine, recently demonstrated. The starting is transmitted through a steel cable, running forward from the catapult over a pulley mounted on top of a "dead man" sunk in the ground, thence back to its attachment to the airplane. Average acceleration is a shade less than that due to gravity. The pull in the cable is therefore a little more than the weight of the airplane. Compressed air, as in early Navy catapults, is used to furnish power to accelerate a big plane from rest to about 60 m.p.h. The catapult consists of two fixed units, each of which weighs more than five tons.

Another application of an established principle to practical usage was demonstrated in Houston, Tex., where a pilotless monoplane was operated by radio control from another plane flying overhead by Robert Autrey. Previous experiments of that sort have been intermittent and purely military. An improved airplane aerial developed by the Bureau of Standards goes by the name of "symmetrical longitudinal T-antenna." Its two flat top elements on short vertical supports, lie along a line parallel to and directly above the axis of the fuselage, and are symmetrical with respect to a vertical lead-in. As free as the vertical pole variety from course errors, this antenna is much superior with regard to ice formation and vibration.

Several experiments have been made in Germany in the last few years with gliders propelled by rockets, the tests invariably ending with a wreck in landing. William Swan of Atlantic City has made two successful flights in the same rocket glider, rising to a height of 300 ft. above the municipal airport. The craft weighs 200 lb. and carries a supply of twelve rockets, alleged to be sufficient to keep it in the air for eight minutes.

Britain adopts airship policy

The fate of airship development in Britain, a matter of conjecture since the R-101 disaster, is decided. To mark time until research can point to a more assured future for the airship as a unit of transportation will be the government's policy. The R-100 will be kept flying in a small way, but with no long trips. About $700,000 will be the maximum annually available for the maintenance of the R-100 and the mooring masts now established, as well as of a small staff to continue research and investigation.

Though government funds are being withheld from airship production Carl B. Fritsche, builder of metal-clad airships is reported endeavoring to enlist private capital in Britain in a trans-atlantic airship route. His speech before the Royal Aeronautical Society was full of conviction that the airship is thoroughly practical for service between New York and England, and made a strong impression in British aeronautical circles. He pictured huge all-metal ships crossing the Atlantic on a two-and-a-half day schedule, his analysis of costs, leading him to believe that fares might be scarcely more than for first-class steamship accommodations.

The stratosphere visited

The story of the balloon voyage of Professor Auguste Piccard and Dr. Kipfer to hitherto unplumbed spaces is now common property. Inside an aluminum gondola, hermetically sealed to keep the pressure to which the aeronauts were subjected near its sea-level value, sustained by 500,000 cu.ft. of hydrogen in a gas bag 100 ft. in diameter, the professor and his assistant ascended to a height of 52,500 ft. in an effort to investigate the stratosphere. All previous records for balloon and airplane were beaten by over 8,000 ft.

FOR NEW YORK-LOS ANGELES SERVICE

One of the five new Northrup Alpha all-metal monoplanes being used by Transcontinental & Western Air on the Los Angeles-Kansas City section of its 24-hour mail service between Los Angeles and New York. Six more have just been ordered.

Incidental result of their trip was an impetus to the construction of airplanes equipped to take advantage of the lower resistance low-density upper air to attain speeds impossible at lower altitudes. A Junkers plane built with the assistance of the German Institute for Research in air communication will be the first to investigate these possibilities.

Army and Navy programs

With comments on the Air Corps maneuvers still g.owing or sizzling on editorial pages, plans are being made for a joint Anti-aircraft and Air Corps exercise in the fall of 1932, to be held near Camp Knox, Ky., with a large air force and three regiments of Coast Artillery participating. Opportunity will be afforded to test the materiel, tactics, and technique of anti-aircraft artillery and to give the Air Corps information regarding the attack of localities defended by gunfire.

Almost simultaneously with the recent Air Corps maneuvers the annual "practice in cooperation" between the Royal Air Force and the Army took place near Farnborough, in England, on a larger scale than ever before. It involved three squadrons of the R.A.F. and three divisions of the Army, one of which was cavalry, the whole emphasis being on experience in cooperation between the forces in the air and in the trenches.

The five-year program of the Navy, attaining substantial completion by June 30 of this year as per schedule, gives the U. S. an unequalled naval air force. By that time all but a small group of the 1,000 planes planned for will be on hand. The completion of the plan will see the personnel tripled, the number of planes increased two and one half times, valuable research work carried out, and the hazards of naval flying reduced by half, all at a cost of $22,000,000 below the original estimates.

Department of Commerce announcements

Once again, for the third time, the effective date for new glider regulations has been extended—this time to Jan. 1, 1932—to permit gliders now under construction which would not be completed by July 1, to be eligible for license upon passing a Department of Commerce line inspection. Any gliders constructed after that date must have stress analyses, and be built either under an approved type certificate or under the equivalent of a Group II classification.

Aircraft manufacturers will have their annual conference with the Aeronautics Branch of the Department of Commerce on July 31 this year, the subject being, as usual, amendments to be made to the Airworthiness Requirements for aircraft. New requirements decided upon then will become effective Sept. 1, allowing manufacturers ample time to modify production plans in accordance with these rules which serve as guide to what will be required of new designs in the 1932 season. In the past, the conference has been in the fall and the results have been effective Jan. 1.

Important legal decisions

The material immediately following, together with references to legal and legislative matters elsewhere in the news pages, is based largely upon the Aviation Law Service prepared by the Commerce Clearing House, Inc. AVIATION is licensed to make use of this service, and is able to give its readers the benefits of the work of an organization specially trained and equipped to insure the complete collection of pertinent material on current legal developments.

Legal precedent for refusing double indemnity on the death of an insured person in an airplane accident has been established by the decision of the New York State Court of Appeals in the case of Gibbs vs. Equitable Life Assurance Society. In reversal of the opinion of the Appellate Division it is held that an airplane passenger on a regular line is engaged in an "aeronautical expedition" and his beneficiary may receive only the face amount of the policy if it excludes such "expeditions" from its double-indemnity provisions.

A sentence of unique severity was imposed by Judge F. Delano at the Boston Municipal Court when he gave Mark E. Ridge of Dorchester a term in the House of Correction for leaving the cockpit of an airplane to perform a feat of daring in violation of the Massachusetts state law. Ridge was charged with having endangered the life of the pilot and of persons on the ground when he made a deliberate parachute jump to a safe landing in a Boston parkway.

The problem of trespass involved in flying over private property continues to divide legal circles. A tentative draft restating the law of torts, submitted to the American Law Institute by E. S. Thurston of Harvard and F. H. Boblen of the University of Pennsylvania Law School, suggested that flight over private property might constitute trespass. Exception was taken by the Committee on Aeronautical Law of the American Bar Association, with the result that no action was taken. This chapter of the tentative restatement of the law was reserved for consideration.

Legislatures consider aviation

The legislatures of the states of Ohio and Michigan have recently acted upon aviation bills long under discussion and set up machinery for the regulation of aviation more or less after the patterns of the Department of Commerce. Michigan is now included in the list of states requiring state registration of all aircraft, whether federally licensed or not, and further assesses a fee on each machine at the rate of two and one-half cents per pound of empty weight. Exception is made for planes licensed or registered in other states which, provided they are not engaged in commercial activity, may be operated within the state for 90 days. All pilots flying in the state, and all aircraft engaged in commercial operations must be licensed by the U. S. Department of Commerce. A Board of Aeronautics is created, to adopt and enforce the provisions of the U. S. Air Commerce Act, and all airports, schools, and clubs must have its approval.

Ohio creates a Bureau of Aeronautics to be administered by a director appointed by the governor and paid a salary of $5,000 a year, and in addition takes the more unusual step of requiring every municipality, large or small, to be air-marked at its own expense. Municipalities are given the right to condemn land for landing fields and air transportation terminals.

Financial announcements

Among reports for the first quarter of 1931 is that of Curtiss-Wright Corporation and subsidiaries, showing a net loss of $1,088,124 after depreciation, interest and other charges, which should be compared with a net loss of $1,620,920 last year. The Curtiss Aeroplane & Motor Company is charged with loss of $46,515 after charges and taxes while Wright Aeronautical Corporation, the engine company, reports net loss of $356,859 for the first three months, to be compared with losses of $61,449 and $383,857 for the corresponding period of 1930. Residual losses, incurred chiefly by the operating companies, were $684,750 in 1931 as against $1,174,614 for the first three months of 1930. Operations of the period were much handicapped by a strike in the Wright plant last December.

Western Air Express reports a net profit of $12,123 after depreciation, assets abandoned or written down and other charges, but before taxes. Air mail operations accounted for $306,747 of the gross revenues while $27,262 passenger revenue brought the total up to $334,009 for the first quarter of 1931.

Reports of Fairchild Aviation and its subsidiaries, given for the year and for the first quarter of 1931, offer complications. Dec. 31, 1930, showed a net loss for the year of $871,522 after expenses and charges. Then the airplane manufacturing company was sold and a group of minority stockholders headed by Sherman M. Fairchild gained control of the remaining activities of the corporation (especially the camera and survey companies), which had been in the hands of The Aviation Corporation for a year or more. The first balance sheet issued by the present management on March 31 shows net tangible assets of $1,136,296 and a net profit of $11,027,

American aviation lost a colorful figure in the death of Charles W. (Speed) Holman at the Omaha Air Races May 17. He was the operating manager of Northwest Airways, he won the Thompson Trophy Race at the Chicago National Air Races last year, and has been prominent in other events.

Shirley J. Short and three companions, endeavoring to break a world's record for speed with a 2,000-kg. load, were killed on May 26 when their Bellanca plane, owned by the Chicago *Daily News*, crashed near Wheaton, Ill. Shirley Short had a high reputation as a pilot, and had received the Harmon International Trophy for safe flying for his record in the air mail service.

Lt. Comdr. Glen H. Kidston, prominent in English aeronautics for many years, was killed in the crash of a Puss Moth in South Africa on May 5. He had recently established a new England-Cape Town record in a Lockheed Vega as part of his program to promote interest in high speed air mail transport within the Empire.

or $0.05 a share on 213,296 shares outstanding. The current operating ratio is 12:1, $207,886 of the $531,514 current assets being in cash. The recent acquisition by the Fairchild Corporation of the Aerotopograph Corporation of Washington to combine with its subsidiary, Fairchild Aerial Surveys, Inc., brings together the operations of two concerns which control over 60 per cent of the total air mapping business of the country, one producing contour and the other mosaic maps.

Organization and production reports

Another corporate change is the acquisition by the Dayton Airplane Engine Company of a controlling interest in American Aeronautical, the manufacturer in this country of Savoia-Marchetti seaplanes and amphibions. At the same meeting at which this step was authorized Capt. Ugo V. D'Annunzio, son of poet Gabriel, for many years resident in the United States and long connected with the American Aeronautical Corporation, was elected president.

The Szekely engine plant at Holland, Mich., sold and shipped 123 three-cylinder engines during the month of May. To date more than 400 orders for this new light engine have been filled, 312 since Jan. 1 of this year, and production is now reported on a schedule of 30 engines a week.

Arrangements for pooling metal construction patents held by three leading English airplane manufacturers, all very active in the development of alloy steel wing spars and fuselage elements, has been reported. The companies are Armstrong-Siddeley, Boulton & Paul, and Gloster Aircraft.

The importance of defense operations to the aircraft industry is attested by recent Army and Navy contacts. Orders for 56 airplanes and 130 engines, costing almost $2,000,000 placed with Douglas, Curtiss Aeroplane & Motor, Fokker, Berliner-Joyce, Wright Aeronautical and the Pratt & Whitney companies were announced by the War Department. The Navy Department awarded contracts totalling $767,942 to the Boeing, Chance Vought, and Pratt & Whitney companies for 40 planes and engines.

Papenerecht, Holland, is the destination of two Curtiss-Wright Juniors, the first light airplanes of American manufacture to be shipped to Europe. They are to be used as demonstrators in a campaign to establish an agency for retail distribution in that country.

A Bellanca photographic seaplane, the first of a fleet of six, was launched recently at the Montreal shops of Canadian Vickers. It is entirely Canadian built, even the Wright engines being assembled at the plant of Canadian Wright, Ltd., at Pointe-aux-Trembles, and will be used in aerial mapping and photographic work for the Department of Civil Government Air Operations.

The plant of the Lockheed Aircraft Company in Burbank, Cal., is operating at about 90 per cent capacity, turning out from eight to ten planes a month. New orders are subject to delivery 60 days ahead.

During the first three weeks of May fifteen planes were sold by the Arrow company. Six of them go to China for use in student training. China is also in the market for transport machines, and recently decided to purchase 40 British airplanes, equipped with machine guns to protect the passengers from bandits, for use on transport lines.

In the Argentine market, too, the British aircraft manufacturers have gotten the best of American competition for a $500,000 government contract. Ten Fairey fighting machines, Rolls-engined, and 15 Avro trainers are included in this order.

Panama has decided to part with its only coast guard ship to obtain funds for the purchase of four airplanes to establish its first national airline. The planes, bought in the United States, will be used to carry mail and passengers, and as ambulances to bring hospital cases from the interior, one plane to be an amphibion to connect outlying sections and islands.

The receiver of New Standard Aircraft Corporation has filed a petition to be authorized to accept an offer of Farman-Standard Aircraft Corporation to purchase all assets now in his possession. The Farman-Standard offer is 10,000 shares each of its common and preferred stock, offered as having a total value of $100,000.

The new laboratories of the Aeronautical Research Institute of the Imperial University of Tokio, just opened in Japan, simplify the testing problems of Japanese industry. The Institute has fourteen acres of floor space for aeronautical investigations, and wind tunnels for testing action under high wind velocity and for simulating the air pressures and temperatures of altitudes up to 6,000 ft.

Activities of autogiros

The autogiro is being put to a variety of uses in an experimental way both in the United States and abroad. The French government proposes to use two autogiro float seaplanes for fleet reconnaissance, while in England the rotating wings are being fitted to float seaplanes, flying boats and cabin airplanes. An American-built autogiro recently delivered by Pitcairn to the Navy, has been classified as XOP-1 and is to be equipped with pontoons and tested for use from carriers and decks of other types of naval vessels.

Another autogiro, the Beechnut, is being tested for its possibilities on long trips by Miss Amelia Earhart, who flew it across the continent by the northern air mail route, and started to return east through El Paso, Oklahoma City, and other southern cities.

Some attention has been attracted by newspaper accounts of an autogiro crash in England. It appears that the engine cut out when the pilot was flying low over a crowd, preventing a normal landing and forcing him to maneuver his machine violently to escape the people beneath. The resultant crash caused minor injuries.

Personnel

Richard W. Robbins, vice-president of the Pittsburgh Aviation Industries Corporation and President of Pennsylvania Air Lines has been elected a director of Transcontinental & Western Air, Inc., with officers in New York City. Major H. S. Martin, vice-president of the Pittsburgh company, has been named president of Pennsylvania Air Lines.

A. P. Kerr, superintendent of the southern division of Eastern Air Transport, Inc., has been appointed assistant operations manager for the entire company with headquarters at Newark Municipal Airport.

Ray W. Brown has been appointed sales manager for Curtiss-Wright Airplane Company in its southeastern territory.

Harry J. Herman has been made manager of Bowles-Agawam Airport, Springfield, Mass.

Statistics of the Month

Material supplementing the statistical issue, AVIATION, March, 1931, appears regularly each month. Page numbers in the statistical issue are given.

PRODUCTION AND LICENSING

(Page 136)

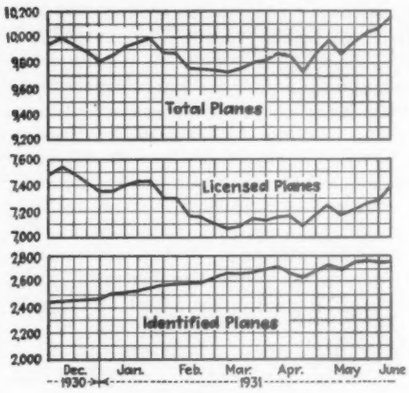
Airplane Production

First quarter, 1931

Monoplanes	236
Open cockpit	152
One place	55
Two place	93
Three place	4
Cabin	77
One place	2
Two place	11
Three place	4
Four place	30
Five place	2
Six place	3
Seven to ten place	14
Over ten place	11
Convertibles	3
Amphibions	3
Monoplanes (data not available)	1
Biplanes	95
Open cockpit	87
One place	5
Two place	36
Three place	40
Four place	5
Five place	1
Cabin (five place)	5
Amphibions	3
Autogiros	9
Helicopter	1
Sesquiplane	1
Military airplane deliveries	302
Airplanes exported*	28
Grand total	672

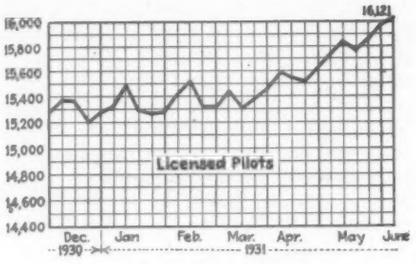
*Does not include planes listed in the above breakdown nor planes exported in 1931 which were manufactured prior to January 1, 1931.

THE production report of the Department of Commerce shows a total of 672 planes manufactured in the United States in the first quarter of 1931, 16 per cent less than during the same period of 1930. Production of commercial planes has fallen almost 40 per cent below last year, the figure for the first quarter being 370, including those for export to foreign countries. Military airplane deliveries accounted for 45 per cent of the total manufactured in the first three months of 1931, and were 60 per cent more numerous than in 1930 when they formed only a fifth of the total production.



Valid airplane licenses and identifications

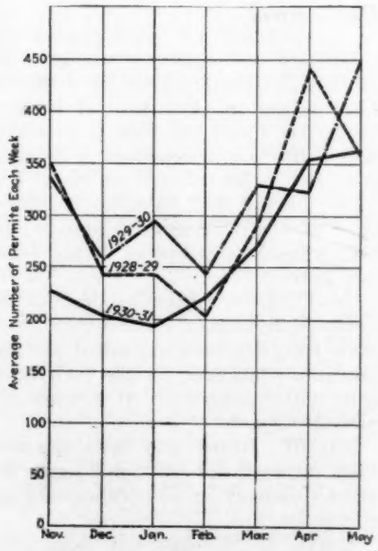
ALL previous records for total number of planes legally approved for service were broken during the past month when the curve not only touched the 10,000 mark, but exceeded it by 158 points. After a set-back the first week in May the number of planes licensed increased at the rate of more than 40 a week, while the curve for planes identified turned steeply upward at first, but became almost stationary the latter part of the month.



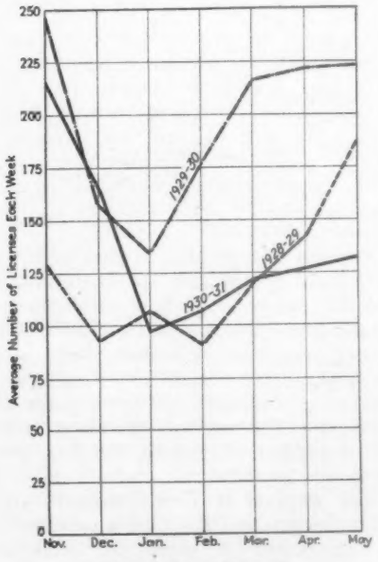
Valid pilot licenses

THE totals of licensed pilots and mechanics also shattered old records. The curve for pilots, recovered from its mid-winter lethargy, continues the upward course set in March and April to a new high point. Though the rate of increase of mechanics is more gradual, the fact that the number licensed increased by more than a hundred during the past month is unusual.

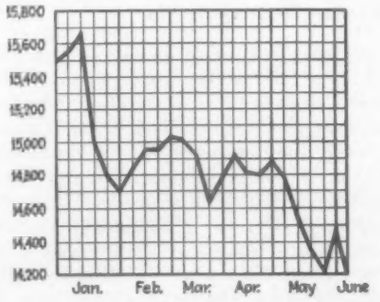
THE trend towards stabilization observable in student permits valid during April seems to have been purely tem-



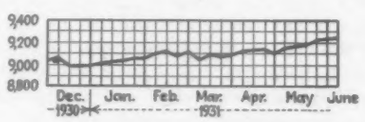
Student permits newly issued, month by month



New pilots licensed month by month



Student permits in force



Valid mechanic licenses

porary. During May the curve dropped to a point not touched since October 1930, the signs of recovery later in the month being decidedly short-lived.

THERE has been almost no change in the rate of issuance of pilot licenses and student permits since last month. The curve showing the average number of student permits issued each week, which had climbed steeply up to April, is nearly straight at a point 20 per cent below the 1930 figure and coincident with that of May 1929. Pilot licenses, increasing at an almost constant rate since March, follow a course far below the curves of both the preceding years.

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AIR MAIL AND TRANSPORT

(Page 153)

Air Transport Operations

First quarter 1930 and 1931

	1930	1931
Miles scheduled	5,804,301	8,385,314
Miles flown	5,044,639	7,427,641
Passengers carried	74,042	65,604
Passenger-miles	14,158,922	15,572,357

THE air transport report of the Aeronautical Chamber of Commerce for the first quarter of 1931, based on monthly reports of 32 scheduled air transport lines, shows a marked improvement over last year. Airplane mileage is 47 per cent greater this year, while passenger-mileage, a more accurate traffic measure, exceeds the 1930 total by 10 per cent. Efficiency, as shown by the percentage of scheduled miles actually flown, is 88.5 for the first quarter of 1931 as compared with 86.7 for the corresponding period of 1930. Number of passengers carried, the only exception to the general record of improvement, has fallen off by about one-tenth.

THE report on passenger service on the 26 air mail routes throughout the country shows 28,368 persons carried during the first quarter of 1931, the largest number, 2,353, being carried on the route from New York to Los Angeles operated by the Trans-continental Air Transport and Western Air Express. A total of 10,626,804 passenger-miles was flown by the planes on all the routes.

Contract Air Mail Totals for March, 1931

(Final report)

Length of route (miles)	21,887
Regular route round trips scheduled	1,127
Miles of service scheduled	2,019,529
Miles of service actually flown	1,809,554
Total weight of mails dispatched (pounds)	724,617
Amount paid to carriers	$1,463,744.92

FINAL figures for air mail service for the month of March have been received from the Post Office Department. The only change to be made in the report given in the June issue is in weight of mail dispatched. The figure for March should be 724,617, making the total for the first quarter of the year 2,054,661 lb.

Accident Data

	Miscellaneous Flying			Scheduled air transport		
	July-Dec. 1929	Jan.-June 1930	July-Dec. 1930	July-Dec. 1929	Jan.-June 1930	July-Dec. 1930
Miles flown	63,000,000	51,767,200	56,502,560	15,940,161	16,902,728	20,042,475
Accidents (total)	873	917	1,116	76	44	47
Accidents per million miles flown	13.86	17.71	19.75	4.77	2.60	2.37
Accidents involving fatal injuries	169	141	160	15	6	3
Fatal accidents per million miles flown	2.68	2.72	2.83	0.94	0.35	0.15
Passenger-miles flown	.....	.....	.....	.....	52,264,616	51,482,633
Passenger-miles per passenger fatality	.....	.....	.....	.....	2,375,664	25,741,316

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ACCIDENT REPORTS

(Page 156)

Fatalities

(Page 156) Accidental death rate for licensed pilots. Per cent of all licensed pilots killed in aircraft

Rate per year	1.8

THE accident reports of the Aeronautics Branch of the Detpartment of Commerce covering the period from July to December, 1930, show scheduled air transport operations to be almost twenty times as safe as miscellaneous flying. Air transports covered little more than a third the mileage recorded by the miscellaneous operations, which include miscellaneous commercial, pleasure, student instruction, and experimental flying, but have only three fatal accidents against their record for the period as compared with 160 in the other classification. Forty-seven accidents, both fatal and non-fatal occurred in air transport operations, making 2.37 accidents per million miles flown, which is about one-eighth the figure for the more varied operations. An "accident" is anything causing injury to a person or damage more severe than the bursting of a tire.

The causes of accidents are strikingly characteristic of the two groups. Errors of personnel were the cause of 53 per cent of the accidents in miscellaneous flying, but only 15 per cent of these in transport operations, while miscellaneous causes of which weather was predominant with 32 per cent, were responsible for 47 per cent of the accidents in scheduled operations and only 15 per cent in the other group. Power plant failures formed 22 per cent of the transport accidents and 19 per cent of those in miscellaneous operations, airplane failures being 15 and 11 per cent respectively of accidents in the two types of flying.

A decided improvement is evident in the accident record of transport flying over the same period of the preceding year. Accidents per million miles flown are a little less than half the 1929 figure, while accidents involving fatal injuries to pilot or passengers are barely one-sixth what they were for the earlier period. The number of passenger-miles per passenger fatality is more than ten times that for the first half of 1930, the only other period for which the figure for passenger-miles is available. The increase apparent in accidents occurring in miscellaneous flying as compared with 1929 should not be interpreted too literally since the rates for the earlier year are based upon an estimate of miles flown which is probably much greater than the actual amount, exceeding as it does the 1930 distance by almost seven million miles.

Reduction of accidents due to the spinning characteristics of certain planes has been one object of the flight-testing requirements for new ships before licensing and has been in a measure achieved. General factors contributing towards spinning may be observed during the test and some undesirable tendencies eliminated, with the result that in the last half of 1930 there was one spin crash to every 50 planes in service as compared with one in every 30 airplanes in operation during 1927, before the flight-testing became general.

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FOREIGN ACTIVITIES

(Page 173)

(Page 173) Foreign subsidies and appropriations

Denmark (1930-1931)	
Direct transport subsidy	$93,400
Total for civil aviation	143,000
Italy (1930-1931)	
Direct transport subsidy	$3,860,000
Total for civil aviation	7,673,800

(Page 174) Annual airplane mileage in air transport, 1930

Denmark	$117,400
Italy	2,760,000

(Page 175) Passenger traffic in passenger-miles, 1930

Denmark	$334,000
Italy	7,700,000

(Page 175) Express and mail traffic in ton-miles, 1930

Denmark	$10,800
Italy	174,200

(Page 177) World distribution of airports, airplanes, and licensed pilots

Denmark	
Civil airports	1
Planes in transport service	4
Licensed civil pilots	8
Italy	
Civil airports	30
Area per civil airport (sq.mi.)	4,000
Planes in transport service	65
Licensed pilots in transport service	178
Miles of air line in operation	8,100
Passenger fatalities*	0.865
Japan	
Civil aircraft	125
Licensed civil pilots	289
Spain	
Civil airports	20
Auxiliary airports	21
Military airports	8
Estimated production of civil aircraft, 1929	16

*Per million passenger-miles (page 176)

The Air Corps' mass migration

Its significance to the Army and to the industry

DULY and dramatically celebrated in the daily papers, the great war of 1931 has run its course. With some 35,000 hours of flying behind them the planes and personnel return to their stations and to their normal activities. The developments of the last fortnight of May can now be considered from the specialized point of view of aircraft operations, and their real significance to the military service and to the airplane industry appraised.

The general efficiency of operations, and the splendid performance of men and of machines, were best shown in general terms by the total absence of serious mishaps. The sensational press had seized upon the fact that the average safety record of the Army Air Corps would indicate a probable total of six deaths in the course of the amount of flying that the maneuvers would require. They had gloated over that prediction. They had grown maudlin over it. They had aroused in their readers the anxious thrill of horrors about to come, and as the maneuvers drew to a close and the promised fatalities ceased to materialize, many of the spectators showed a surprise bordering on disappointment. The absence of accident was all the more notable in view of the strain to which the personnel were subjected, flying in formation three or four hours each day and often short on sleep and getting their meals when, as, and if the chance offered.

The exercises would hardly have been carried out without fatalities if the movement had been made in response to actual emergency suddenly arising. The conditions of war necessarily differ from those of peace, and they can only be approximately simulated. They comprise the deliberate assumption of hazards that cannot be

The pilots took great pride in making their planes toe the chalk line exactly and without external assistance. Above: An attack squadron at Dayton. At right: An observation group at Mitchel Field. (Photograph by courtesy of Army Air Corps)

The squadrons size up the possibilities of defending New York City from the air. Coming down the river over the new Hudson bridge

allowed in peace times. They involve some extemporization of plans, whereas the maneuvers of a month ago had been worked out and scheduled in almost every detail from one to four months before the first plane started for the concentration point. Account must be taken, too, of the fact that the planes did not carry the full military load.

Way clear for publicity

Most of all, real war in the air differs from the simulated variety in publicity. In war the press is anxious for all the information that can be secured, and the problem of press relations is largely one of censorship. In peaceful exercises the endeavor is to get as much press attention as possible, combined with a reasonably fair interpretation of what is being done. During the late maneuvers the high command had no thought of censorship. Reporters and photographers were welcomed everywhere. Even the rule against photographing crashes was ignored for such minor accidents as occurred, and the photographers were allowed free range.

Publicity for military exercises is a very excellent thing up to a certain point, but not beyond the stage where it takes control of the operating plans. Air Corps maneuvers should be kept military. That they are also a very striking public show is a happy incident, but it should be only an incident. They ought never to be tangled up with a program of public entertainment in no way military, imposing upon the Air Corps units the obligation of putting on a spectacular display. The Army ought to run the entire affair and be free to make its plans and change them at will without consulting anyone except those directly and necessarily concerned in the movement of the planes. To be specific, dedications such as that of the New York Municipal Airport have no proper place on a maneuver program.

Air parades and tactics

From the most narrowly military point of view, the massed reviews of 600-odd planes would be equally subject to challenge. They meet a popular ideal of great forces going forth to combat en masse, but a miscellaneous grouping of great bodies of pursuit, attack, observation, and bombardment planes, proceeding in column of squadrons, has no more relation to the way in which aerial combat is conducted than has close-order infantry drill to trench warfare. Like infantry drill, the reviews certainly have great use. They are a test of discipline, and of doctrine, and of ability to adhere to a plan. They are useful in developing flying technique, but they are without direct tactical significance. Most of the reviews during the maneuvers were carried off with extraordinary success, although in one or two cases the timing was inaccurate and there were long gaps in the line of parade. In the review over Floyd Bennett Field, on the other hand, in spite of a low ceiling, threat of an early storm, and very bumpy air, 607 planes went by in fourteen minutes. At least twelve machines passed during each minute, and there were only three of the fourteen minutes in which the number passing fell below 30, only two in which it rose above 60.

The maneuvers have made it even more apparent than it was before that an air division is purely an administrative unit, and that the group of three or four squadrons, or under very favorable conditions a wing of two or three times that many, is the largest unit that could be tactically employed as a unit with all of the planes having any direct contact with each other. When more

The Air Corps maneuvers have been generously exploited by the newspapers. Superlatives have been deservedly lavished on the skill of the pilots and on the spectacular quality of their displays. We have written here for those professionally engaged in aeronautics, not for the miscellaneous public, in commenting on the materiel aspects and how some of the difficulties were overcome. The story of the administration and of the supply organization is less exciting than that of the flying, but it is of even greater fundamental importance.

machines than that are in the operation, everything depends upon communications and upon the synchronization of watches and getting each unit to a stated place exactly at a stated time which will fit it in with the general schedule. Occasions arise where even the group must be dissolved into its component units. For instance, when Major Ryan's observation group made a brave attempt to complete its assignments through northern New England, the weather became impossible. He radioed his squadron leaders to take charge of their respective units and get them to the ground in the best fashion possible.

Servicing problems were ever with them. Top: A small selection of the tank-truck fleet assembled at Dayton. Center: Using a long enough hose to service three planes without moving the trucks. Bottom: Preparing to supply lubricants.

Radio earns its wings

Communication of a highly reliable character was vital. Radio communication between planes and between the planes and ground stations was used to a greater extent than ever before in an Air Corps exercise. The system worked extremely satisfactorily, the most serious difficulties coming from the unavoidable interference of powerful commercial stations which in time of national emergency would be subordinated to military exigencies and would cease to be a hindrance.

Plane-to-plane radio was used for tactical movements, and for the exchange of weather and special information. Plane-to-ground communication was used for the dissemination of weather information and, in one instance—at Springfield, on the return from Boston—the service was used to speed up the landing of the units in the face of approaching bad weather. In this case, the officer who superintended the landings ordered the units in from their waiting areas in turn in advance of the carefully timed schedule as the large field became clear.

Wing and group, and in some cases, squadron commanders carried two-way sets. Flight leaders carried receiving sets. Orders originating with the group commanders as a rule carry out the doctrine of the division orders as announced on the ground. These are not to be changed except when weather or some other factor necessitates. Miscellaneous comment between the planes was exemplified by a conversation between a pursuit group commander and his subordinates in which he announced the name of a certain town over which the planes were then flying in Ohio, and cautioned the pilots to note that the emergency field at that point was incorrectly located on their maps.

Both permanent and portable markers told each squadron commander where to take his unit. The bombers were so self-sufficient that they even carried their own chocks, branded as a safeguard against misappropriation.

Weather closely checked

Other notable examples of the value of the radio for meeting special conditions arising after the planes were in the air were afforded by almost every movement, chiefly because of the vagaries of the weather.

During the parade down the Hudson River valley on Saturday, May 23, an advance plane posted over New York harbor watched closely the movements of a dangerous-looking thunder storm and kept the units advised of the weather in general. The scout was prepared to advise the commanders to scoot for their base fields at the first sign that the storm would strike the column if it penetrated the harbor area. While the planes were returning to Springfield from the Boston display a plane flew out from Springfield toward them and reported the weather. This was important because the ceiling threatened to lower and forced landings on any scale in that territory would have meant many machine casualties.

The travels of the First Air Division constituted primarily a problem of supply and organization. To use the approved technical term, they were a study in logistics. Their tactical and strategical significance was at most

very secondary. Aside from the enormous magnitude of the movements involved and the number of machines that had to be handled, their most interesting feature was the extensive coordination of military and commercial facilities.

Corps largely self-sufficient

From that point of view the results appeared admirable, but they would have been quite as admirable in most cases if the landings had been made in an open prairie somewhere instead of on a fully equipped airport. With a few exceptions, the airport management and personnel never needed to enter upon the scene. Almost no use was made of the commercial hangars, and very little of the shops. When in the New England area there were several instances where it was considered most economical to utilize civilian repair facilities, and this work was paid for by Army vouchers, but in general the planes were cared for, and such service work as was needed was done, by the personnel of the squadrons.

The one non-military activity upon which the maneuvers absolutely depended, apart from their use of commercial airports as landing fields, was the oil industry. The truck drivers and crew chiefs of the oil companies were, again with rare exceptions, the only civilian personnel that had any share in the operations.

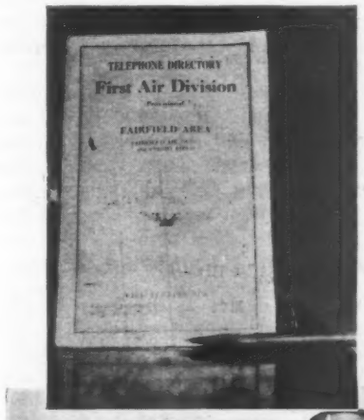
Fueling experiences valuable

The experiences of the fortnight left no doubt that a large group of planes could be more conveniently and quickly supplied with fuel by the use of gas trucks than by taxiing the planes themselves up to pits. A partial compromise between the stationary airplane and stationary fuel source was made in some cases by equipping the trucks with extra lengths of hose, to a total of about 50 ft., permitting the fueling of two or three machines in a line without moving the truck. That seemed the best and speediest of all the arrangements tried. The general rule was that servicing, including all the time off for moving trucks about and reflecting on what was to be done next, averaged about 8 min. per plane per truck (somewhat more for the bombers). With eight trucks at work, which was a representative number for intermediate fueling points, the work could then be finished in about 1 min. per plane. At Buffalo, for example, 77 pursuit planes were serviced in 85 min., and 110 observation planes were cared for in 110 min. at Cleveland.

The work was done in Dayton by the Standard Oil Company of Ohio, in Chicago by the Standard Oil of Indiana, in New York by the Richfield Oil Company, and in New England by the Colonial Beacon Oil Company. As the operations around New York extended over the longest time and the greatest amount of flying, the organization required there offers a good example for examination, and can be taken as typical. The contract was awarded, as is habitual with government contracts, after competitive bidding, and included a proviso that the work of servicing must in every case be completed within three hours. A detailed schedule of requirements was turned over to the oil company several weeks before the maneuvers, showing a total of 231,600 gal., and a maximum of 64,700 to be delivered in one day. The fuel was fighting grade gasoline, with 3 c.c. of ethyl fluid per gal. To meet the specifications on servicing time the Richfield Company mobilized 46 trucks, including a number obtained from associated companies or leased from fuel oil supply companies. (In Dayton there were 58 Sohio trucks at work.) Trucks that had been used for furnace oil had to be steam-cleaned, washed out with aviation gasoline, and fitted with new hose and new strainers before being put to work. The trucks were all fitted with power pumps capable of delivering up to 50 gal. per min., although in practice the design of the airplanes did not permit of taking fuel at any such rate as that.

Tank trucks given N. Y. escort

The first serious difficulty, which could have been lightly over-ruled in war, arose when the New York City authorities announced that the use of a truck with a power pump for transporting gasoline through the city was illegal and that the passage of the vehicles from the company's storage base in Long Island City to the flying fields farther out on Long Island could not be permitted. That decision was finally reversed by higher authority on the condition that the trucks be given special protection, and they traveled the streets, and even the highways far out on Long Island, completely surrounded by a formidable guard of motorcycle police. Each truck had a definite station assigned before the planes arrived, and the responsibility of servicing from



Top: In Dayton the division even had a formally printed telephone directory, with 120 numbers listed. Center: General Foulois' flag flying before division headquarters at Fairfield. Bottom: Division headquarters at Mitchel were extemporized, and offered more space than privacy.

Top: The division traveled light. The baggage of an attack squadron assembled before a move. Bottom: When rain struck Chicago hundreds of planes had to be taxied through these conditions.

fifteen to twenty planes. As soon as the machines were parked the trucks were driven down the lines, taking the planes in order. The total capacity of the trucks considerably exceeded the largest total requirement for any one day, so it was never necessary to send a truck back to the storage base for reloading and have it come out again on the same day. In one case in the Middle West the need for fuel proved to outrun the total capacity of the trucks on the field, and their contents had to be hastily eked out from the airport's own supply.

The only serious hitch in the servicing work around New York occurred when a number of the trucks became bogged down in the soft ground and had to be hauled out and helped along their route by tractors. There had been a similar experience on one of the Chicago fields, but in that case the rain was so recent and the ground so soft that the trucks could not move at all, and the planes had to be started up again and taxied to the edge of the concrete apron for fueling.

Made-to-order emergencies

Chicago's rainstorm gave a beautiful example of the extent of the delay and uncertainty that may result from even a slight change in the conditions under which a carefully-planned exercise is carried out. The planes of the attack group landed, were taxied to the designated location, staked down and covered up early in the afternoon. After about an hour of waiting there came the report that the gas trucks would be unable to reach them, and they were all uncovered, warmed up, taxied across the field, serviced, started up again, and taxied back. With only 50 machines in the group, arriving some time after the other planes at that particular field had been taken care of, it was almost five hours after landing before the servicing was completed, and another half hour before the pilots were able to leave the field for the hotel.

The experience was a fortunate one. If the weather had been perfect throughout, and if everything had gone exactly as scheduled, the maneuvers would have lost much of their value as a military practice. In the event of war something always goes wrong and upsets the pre-arranged plan. So true is that, that it would be well in future years deliberately to introduce emergencies, even if they have to be imaginary ones. It would be well to write out a miscellaneous lot of possible contingencies and weather changes and disasters on slips of paper, shake them up in a hat, and draw one out and from that moment proceed as though that particular misadventure had actually arisen. There is no real test of the flexibility and elasticity of staff organization unless or until the unexpected happens.

Keeping the planes serviceable

Supply and maintenance constituted a major problem, and the organizations holding those responsibilities won much warm commendation from all quarters. The maneuvers provided not only a test of the whole supply and maintenance system, but also a basis for comparison between the value of service squadrons and the air depots supplemented by the regular plane crews for assisting the corps in the field.

The air-depot and plane-crew combination was relied upon chefly in this year's maneuvers, the only fixed service squadron used being that regularly based at Mitchel Field. Experience indicated that operations within a few hundred miles of a depot could be maintained at a high standard. Operations so far away from a depot that frequent and quick transit between field groups and depot would not be available, would constitute a different problem.

The most distant field base in this case was Boston, approximately 350 mi. from Middletown. The Corps drew on the Fairfield depot when west of the Ohio River, and on Middletown while east of the river.

Supply system highly efficient

Using the depots as the main supply bases for everything from dope to engines and wings, a fast and smooth-working system of requisition and transportation was essential. The division supply officer carried the main responsibility in the field, assisted by a supply representative in each group. At each field where units were based were civilian employees of the air depot who were thoroughly acquainted with parts and procedure and could order and deliver supplies efficiently.

A mechanic needing a new magneto, for instance, would file a requisition with the group supply authority. Since the group would not carry such an

About 35,000 hours of flying produced no crashes worse than this. Top: Ten minutes after striking a ditch in landing short of the field. Bottom: Two hours later.

article (though it would have such articles as propellers, grease, and spark-plugs), the requisition would be passed on to the division supply agent. If it so happened that a permanent branch supply storeroom existed in the area—as when the planes were based at Mitchel and nearby fields—the order would be filled immediately from the post stock. If not, the order would be telephoned to Middletown or Fairfield, and the magneto would be shipped by the next plane, reaching the mechanic within four to six hours of the time he filed the requisition. When repairs would require more than 24 hours the plane automatically was retired from the maneuvers.

In order to fill an order promptly and reduce the time a given plane would be unservicable, the supply division operated eight Douglas C-1 transports and bombers at approximately two-hour intervals between the depot and the supply headquarters in the field. On the last day the planes were at Springfield, Boston, and Hartford, the supply transports made fourteen round trips between them and Middletown.

Everything was carried up to but not including wings for bombers. Engines, and wings for the pursuit and observation planes, were occasional items in the cargo. On one representative day there were 104 requests from Middletown, each request involving an average of more than ten items. On another day four engines were delivered by bomber transports. Included in the supply planes was one C-1 fitted out with a welding set and other repair apparatus; this was kept busy answering calls from the various fields.

Few extensive repairs

Thursday, May 28, was maintenance day in the program—merely the regulation weekly check of engines and planes as carried out at all Air Corps posts. Planes were washed, engines checked over, spark plugs changed, and larger items repaired or replaced as shown desirable by inspection. Remarkably little extensive replacement and maintenance was required. Up to the time the planes left the New York area for Washington and nearby points only eight machines had been forced to retire completely from the maneuvers. Two were washouts, six were major overhauls which the depots would have to handle. Only two planes had required major replacement, such as the substitution of under carriages, wings, etc. They continued in the exercises. The mechanics did excellent work with the tool kit each plane carried, and one was reported to have included a complete connecting rod assembly among his limited equipment.

The general organization was of course on strictly classical military lines, with an almost religious adhesion to those mystic symbols which denote the divisions of the General Staff. "You say you want the information division?" quoth the telephone operator at Fairfield. "We have no such division. Do you mean G-2?" If a criticism could have been made, it would have been that there was too much centralization of every sort. When the staff arrived everyone learned exactly what was going on and what was to be done next, but pending their arrival a fog of uncertainty hung over the area of operations, and the staff could only be in one place at a time. While the division was on the way from the Middle West to New York, the most diligent inquiry at all of the fields and military headquarters in the neghborhood of the city produced less information about the movement and the probable time of arrival than could be had from any New York newspaper office.

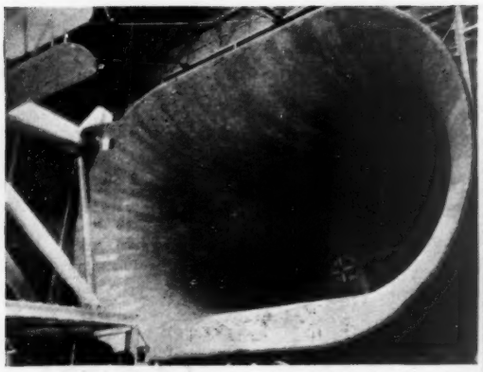
When a starter switch stuck just as starting time approached servicing went into mass production, with all the mechanics in the squadron rushing to the rescue. Below: Portable supply bases were established in tents with hastily assembled racks to contain the frequently required tools and servicing material that moved with the squadron.

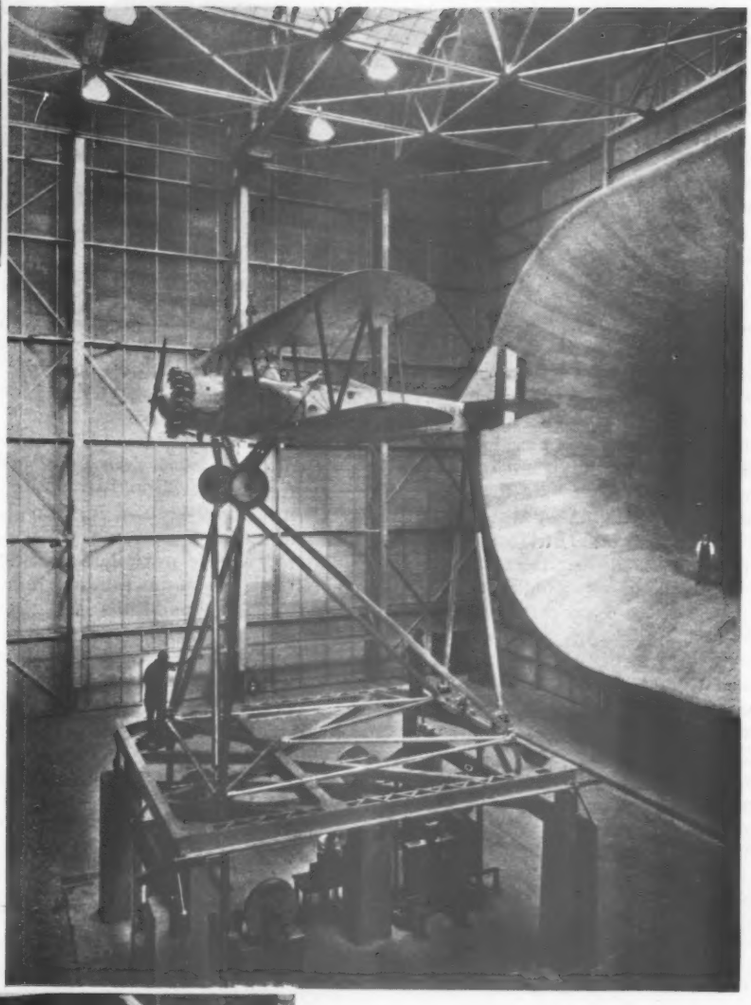
Shortage of clerks a handicap

In spite of the long period of preparation available the commanding officer and his staff labored under some disadvantages, one of the most serious being a shortage of clerical help. Officers of all ranks were to be found painfully pecking out their own memoranda and reports on their own typewriters. Armies in the field still operate essentially upon a theory conceived before Christopher Sholes invented the writing-machine, and enlisted men are seldom notable for their efficiency as stenographers. In time of war women would inevitably be enlisted, as they were in the late conflict, for clerical service everywhere except in the front lines and on naval vessels at sea. There appears no reason for the Army engaged in peaceful maneuvers to deny itself adequate professional clerical service. A plan for mobilizing a force of stenographers and typists for Air Corps office work would be likely to be of much more immediate practical value in any hostilities in the near future than would the scheme for enrolling feminine combat pilots which has lately received so much attention.

A conspicuous feature of the fortnight was the accuracy with which the planes were handled. Perfect formation flying by the Air Corps and the squadrons of naval aviation has come to be taken for granted, but seldom if ever before have formation landings and take-offs been practiced with such large numbers of planes, with squadrons coming in in such close succession, and on unfamiliar fields. Even where the ground was full of soggy spots and pools of water, landings were made in close formation. In a typical landing (not by any means an exceptionally good one) of an observation group the last machine of a squadron was on the ground in eleven seconds after the first one touched its wheels, and another squadron was landing 45 seconds thereafter. Fifteen minutes after the appearance of a group of 50 machines over Mitchel Field they were all parked in orderly rows along the whitewashed lines laid down for each squadron.

The control on the ground, with no help whatever from ground personnel, was even more spectacular than the formation flying. A score of taxiing planes, sometimes heading into what looked like an impossible tangle, were easily and quickly swung into column and then brought to the positions, in most cases literally within inches of the exact locations, that had been marked out for them. To the use of separately controllable brakes, more than to any other feature of modern airplane design, the maneuvers owed their success. The savings in time, and in man-power on the ground, which could be set directly to the credit of the brakes and brake controls were incalculably large.





Above: View into the exit cone of the wind tunnel showing the 34-ft. propellers and the dividing wall between them. Right: A Vought Corsair mounted on the balance. The streamlining of the supporting struts shown in the upper picture was applied after this photograph was made.

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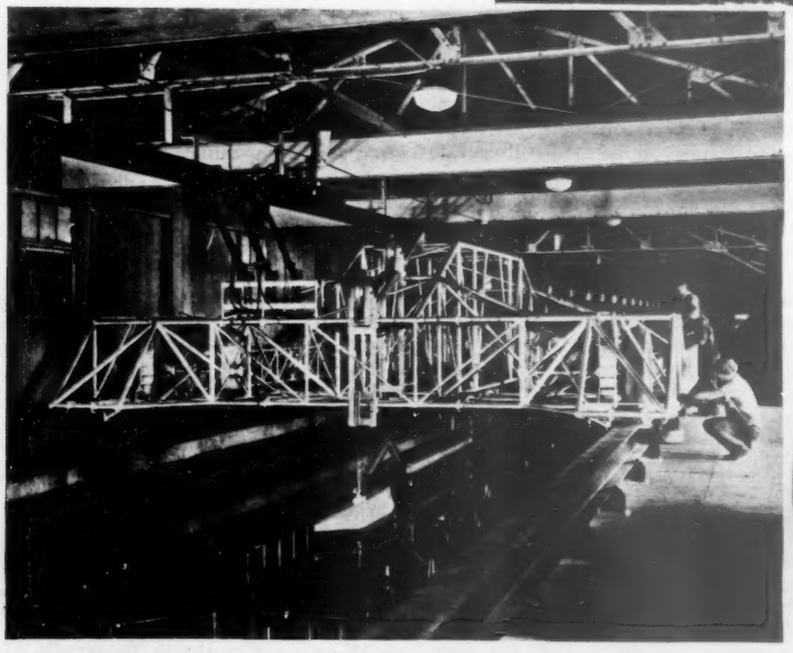
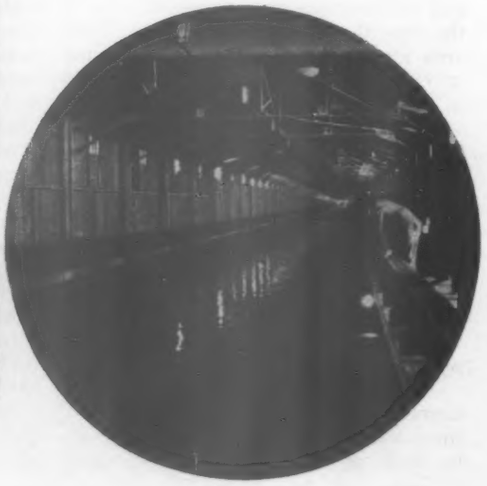
The N.A.C.A.'s great wind tunnel and towing basin at Langley Field



Left: Ready to test a flying boat hull model in the new towing basin. Note carriage construction, and the pneumatic tires. Below: A general view up the 2,000-ft. tank.



For the first time in aerodynamic research history, tests of a full scale airplane are to be made in a wind tunnel sufficiently large for this purpose. This tunnel, which is by far the largest in the world, has just been completed at Langley Field and, together with a recently constructed towing basin, also of gigantic proportions, was dedicated during the recent N.A.C.A. Conference.

Aeronautic progress and the N.A.C.A.

ON THE threshold of what promises to be an unparalleled period in the history of aerodynamic research, the personnel of the N.A.C.A. Laboratories at Langley Field, Va. paused on May 27 to welcome technical representatives of the aeronautic industry to the Sixth Annual Aircraft Engineering Research Conference. Important as past conferences of this sort have been, the most recent meeting may be characterized as the most significant of all, for it was marked by the dedication of two new pieces of equipment that should contribute immeasurably to the store of aeronautic knowledge. The inconveniences and inaccuracies involved in applying data based on model tests to full-scale design are too well known to need comment here. For the first time in the history of aerodynamic research, it is possible to test a full-sized airplane in a wind tunnel under controlled conditions. The new full-scale wind tunnel offers possibilities for research which have hitherto been unavailable.

In the field of flying boat and seaplane design also, existing data have been quite inadequate due again to the physical limitations of available testing equipment. Towing basins for models of ship hulls have been in use in this country and abroad for a relatively long time, but with the advent of the flying boat whose characteristics are totally different from those of ordinary surface craft, tests in existing water channels have been generally quite unsatisfactory. The new towing tank at Langley Field was designed and built primarily for a study of aircraft floats. Its size, and speeds available for towing are so much greater than those of any similar piece of equipment that it should open up totally new fields of research. The placing in commission of these two major pieces of equipment marks a step forward in aerodynamics, of utmost significance to the entire industry.

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The industry listens

AFTER a brief address of welcome by Dr. Joseph E. Ames, chairman of the Committee, Elton W. Miller, chief of the aerodynamics division first commented on a systematic study of airfoil profiles undertaken by E. N. Jacobs and John Stack in the variable density wind tunnel at high Reynolds Numbers. An analysis of sections which are most widely used has indicated that they are all very much alike except in camber and thickness. By taking sections which are in popular use today, such as the Clark Y and the Göttingen 398, and reducing them to a symmetrical section of zero camber, a surprising uniformity of outline results. For the resultant symmetrical section it has been found that maximum lift is obtained for thicknesses ranging from 12 to 18 per cent of the chord, and that the minimum drag varies uniformly with thickness, being twice as high for a section whose thickness is 21 per cent as it is for one with a thickness of 6 per cent of the chord. Preliminary results have indicated also that a section with a mean camber of 6 per cent, with maximum camber located at 50 per cent of chord, and with a thickness of from 9 to 12 per cent, would yield maximum values of lift for the least increase in drag as compared with the basic symmetrical section.

The investigation of nacelle location with respect to a monoplane wing has been continued during the year with every indication that nacelles faired completedly into the leading edge of a wing are considerably better from the standpoint of high speed and maximum climb than for any other of the twenty positions above or below the wing which have been studied. In order to check landing characteristics, tests have been made on wing and nacelle combinations with propeller rotating and with propeller locked, and it has been indicated that the lift is very little affected under either condition.

Mr. Miller concluded his section of the discussion with a description of the work which is being done in the propeller research tunnel on an exceptionally large model of the new airship Akron, and a description of airplane spinning characteristics. In connection with the airship investigation, drag data on a number of ships have been compiled which indicated that the minimum drag is to be expected with a fineness ratio of approximately 6.5. Decreasing fineness to 2.5 or increasing it to 10 caused an increase in the drag of approximately 100 per cent. In connection with the spinning problem, model tests have indicated that incipient spinning may be eliminated for all commercial airplanes by proper stability and control at high angles of attack. In general, increasing the moment of inertia about the Z axis and decreasing it about the Y axis makes for bad spinning condition. The degree of sideslip in spin is sometimes important, but it is not always a maximum in the worst spin.

Following Mr. Miller, J. W. Crowley, chief of the flight test section, described some of the full scale investigations which were being made in connection with the loading on wing tips in flight, and the effects of various wing

tip shapes. It has been found that the highly concentrated load at the tip of a rectangular wing can be very much reduced by even a slight rounding. A special shape, a modified eliptical tip with negative rake, has been designed by the N.A.C.A. which eliminates the usual tendency of the center of pressure to move backward at the wing tip. Mr. Crowley outlined also the investigations which are being made for the determination of leading edge loading. This work is almost completed and a report is to be issued shortly, giving the results and the formulas to be used in design. He mentioned briefly the work which has been done on the determination of tail loading and the rationalization of design formulas for this purpose. This material will also be made available at an early date.

The full scale spinning investigation which has been conducted under the direction of Fred Weick has indicated that any airplane can be spun if enough longitudinal control is available to maintain angles of attack at which the wing is completely stalled. Tests have shown that most airplanes have but slightly more control than required to stall the wing, and it seemed logical that if some sort of mechanical stop is put on the elevators to prevent their being used to put the airplane in a completely stalled attitude, spinning would be impossible. This has been demonstrated by making certain modifications on a Verville Trainer, both in the control system and in the undercarriage. Shock absorbers with a 13-in. travel were fitted, and with the limited elevator control, it has been possible to make landings by gliding the machine straight into the ground at an angle of attack just under the stalling point. Landing run has been reduced very materially and landings up to a vertical velocity of 30 ft. per sec. have been made with only minor damage. Mr. Weick described also the work which has been done on the McDonnell airplane which has been purchased by the N.A.C.A. Investigation of slot contours has been caried on to determine the proper angular relations between auxiliary airfoil and the main wing, both for controllable and fixed slots. It was suggested that lateral control would be very materially increased by providing a fixed slot at the wing tip only. The increase in drag would result in a loss of top speed of about 2 m.p.h.

The work of the power plant section was discussed by Carlton Kemper. He described a hydraulic, hub torque dynamometer which the laboratory has developed for altitude work.

The fire hazard resulting from the bursting of gasoline tanks over hot exhaust manifolds in crashes has long been recognized. The British Air Ministry has determined that the maximum safe operating temperature of exhaust stacks from a fire prevention standpoint is 650 deg. F. The N.A.C.A. has designed and built an ejector type manifold in which it has been possible to obtain normal temperatures within the safe operating range. Another means of reducing fire hazard is in the use of the so-called "safety fuel." Gasolines of this type, made by a hydrogenation process, are now available which have a distillation temperature some 200 deg. above ordinary aircraft gasoline, and which yield performances but slightly under those for the latter. Such fuels are introduced into the cylinder by direct injection and are fired electrically. Further work is being done with the pure diesel types of engines using direct injection and compression ignition. A continued study is being made of jet forms and combustion rates in the spray photographing laboratories.

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The industry looks

EVEN a non-aeronautical visitor is greatly impressed by the new full-scale wind tunnel from the standpoint of sheer size. Designed to accommodate machines of spans of 45 to 50 ft., it measures 60x30 ft. at the throat, and will produce wind velocities up to 115 m.p.h. Its two 34-ft. four-bladed propellers are each driven directly by a 4,000-hp. electric motor supported in individual streamlined nacelles in the slipstream. The two propellers are arranged side by side, and deliver air into separate return passages. The two streams, after passing through several sets of colossal guide vanes, converge in a huge rectangular chamber behind the throat, and are guided smoothly into the entrance cone. The tunnel is of the open throat type with the airplane under investigation mounted in the airstream from below. Streamlined struts transfer the loads to the balance platform. Angle of attack is controlled by a motor-driven adjustable strut under the tail, and the angle of yaw is set by turning the entire supporting system on the balance platform. Air forces on the machine are read directly from six Toledo scales incorporated in the balance. A unique feature permits the simultaneous recording of all six readings from a single push-button station on the floor. The entire unit can be controlled and operated by two or three men, and it is predicted that polar determination work which ordinarily would require a month or more of continuous flight testing may be accomplished more accurately in the tunnel in the course of one or two hours. This apparatus is in charge of Smith J. De France, of the engineering staff.

Second only to the full-scale tunnel in size and importance, the towing basin exhibits many unusual features of design and construction. The channel proper, 2,040 ft. long, 24 ft. wide, and 12 ft. deep in the center, is built of reinforced concrete, and is bridged by a towing carriage running on a pair of parallel H-beams along each edge. The carriage is unique in that it is built up of welded steel tubing and plates, and, instead of being mounted on steel wheels as is the usual practice, is carried on four special pneumatic tires, inflated to 125-lb. pressure. Four solid rubber tired wheels mounted horizontally on suitable brackets, and bearing on the webs of the H-beams, prevent it from running off the flat topped track. The carriage is operated by four electric motors, each geared to one of the four driving wheels. Current for the motors is taken from overhead wires through suitable trolleys. The entire control of the towing carriage, except for emergency stops, is from a desk located at the south end of the channel. The model under test is carried on a towing arm, to which a dynamometer, and other necessary measuring instruments are attached. Two observers ride with the model, and one operator is stationed at the control desk. An unusual speed recording device keeps accurate records of the movement of the carrier. The timer incorporates a photo-electric cell which picks up flashes of light transmitted through a series of holes spaced on 5-ft. centers along a flat steel tape suspended from the roof trusses over the center of the channel. The tape travels continuously through the instrument as the carriage progresses along the tank. Models tested are about 10 ft. long, and may be towed at speeds up to 50 m.p.h. The towing basin has been constructed and will be operated under the direction of Starr Truscott.

The variable density tunnel has been remodeled slightly in that a d.c. motor has been substituted to give better speed control, and the angle of the exit cone has been slightly flattened. The old atmospheric tunnel has been replaced by a rectangular 7x10 ft. tunnel of latest design, incorporating many interesting features. By means of accurate wind speed control, and standardization of model sizes, it has been possible to calibrate all balances directly in coefficient form, so that curves can be plotted directly from the balance readings in a great deal less time than was formerly required to convert and plot. This tunnel is of the open throat type, and is equipped with a special balance for spinning investigation. One of the interesting features of this apparatus is the use of ball bearings throughout. This application was also noted in other new wind tunnel equipment of the N.A.C.A. Housed with the new 7x10 ft. tunnel is the new vertical tunnel intended primarily for spin tests. The special balance required is under construction, and will be in operation at an early date. In the meantime this tunnel is being used in conjunction with the regular atmospheric tunnel testing program. The high speed tunnel, and a refrigerated tunnel for ice formation tests were also shown. In connection with the latter, an airfoil with a steam heated

leading edge has been built and tested. Steam is obtained from a small boiler attached to the engine exhaust. It has been determined that there is about ten times as much heat available at the exhaust as is required for the prevention of ice by this method. A series of slots immediately behind the leading edge section on the upper surface are provided to catch the water resulting from the melting of the ice, and to prevent its re-freezing.

A number of interesting exhibits were shown in the power plants laboratories. The single-cylinder engines for fuel and supercharging tests were explained in some detail, and three types of supercharger were demonstrated. The hub dynamometer was operated, and the apparatus and methods employed to photograph fuel injection sprays in engine cylinders shown. An interesting point was mentioned in connection with the investigation of air cooling of cylinders in that it has been found that the cooling coefficient on a finned cylinder is 25 per cent higher when the fins are presented at 45 deg. to the airstream than when they are fixed parallel to the air.

The flight section exhibit included a number of pieces of equipment which had been described in the several technical sessions. Two Douglas planes used for pressure distribution studies indicated the way the recording apparatus was actually mounted for flight tests. The McDonnell airplane and the Fleet used in the spinning investigation, equipped with disposable weights on wings and fuselage were on the floor for close examination, and one of the new ejector type exhaust coolers was mounted on a radial engine. An interesting accessory was mounted on a Fairchild monoplane. A smoke box was supported ahead of the leading edge well out on one of the wings, so that cameras could be arranged to photograph the smoke patterns when the machine was in flight. A full scale study of air flow over wings under various conditions is thus made possible.

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The industry speaks

THE afternoon session was characterized by relatively fewer questions and suggestions from the visitors than in previous years and as usual Dr. Ames presided. Following a few words from Ivan H. Driggs, the first speaker, Capt. R. W. A. Brewer asked for information regarding air scoop design for cooling four and six cylinder in line engines. At Dr. Ames' suggestion, Carlton Kemper replied that this work would be a relatively simple matter to conduct in the large wind tunnel.

A study of vibration in all of its phases was suggested by Frank W. Caldwell, whereupon John Peace of the Pioneer Instrument Company reported that his organization was at work developing a device to record vibration photographically. At this point, Henry Reid of the N.A.C.A. explained that this study would probably be made in connection with the general program.

Necessity for a complete investigation of the conventional assumptions concerning slipstream effect was pointed out by C. H. Chatfield who suggested that, as the extreme conditions affecting slipstream production were moving farther apart with the introduction of direct-driven propellers of very high rotational speed on the one hand and of geared propellers on the other, it was probable that the older assumptions were not valid for the entire range. In this connection he also passed on a suggestion offered by C. N. Monteith for an investigation of stability with power on. Replying, Mr. Crowley of the flight test section reported that his group was investigating stability with and without power, but he felt that such an investigation could be conducted more satisfactorily in the full scale wind tunnel where it would be possible to control more completely the actual conditions of flight.

In connection with the air-cooled engine cylinder finning research, Roland Chilton made several suggestions, the most important of which was that tests be made on more than a single cylinder head, simulating actual conditions by providing adjacent heads and a nose. To assist in the work he offered cylinder heads from standard Wright engines.

Attention was called by Edward P. Warner, editor of AVIATION, to the fact that practically all of the important problems now confronting aeronautical engineers were under way and that future laboratory work would consist largely in an extension of present researches, rather than the initiation of new phases of investigation. He remarked that the existence of the full-scale tunnel would permit further study of the nacelle and propulsive efficiency tests and suggested the study of a light two or three-engined machine as part of this program. He also suggested further research in matters pertaining to riding comfort, including ventilation, vibration, severe bumps and other contributing factors and he brought out the need for an extension of the studies of aerodynamic performance and interference to include the effect of fairings, fillets, and minor protuberances in the air stream. Dividing the problems of aeronautical engineering into two classes, one concerning the machines to be flown by expert pilots, and the other machines for novice pilots, Mr. Warner drew attention to the distinctly different problems involved in the two categories. He suggested that the committee study the effect on performance of slots, flaps and other aerodynamic novelties and cited the purchase of the McDonnell airplane as a beginning in this direction.

Further data on the use of cowling in connection with small nacelles and on cowling in tandem engine arrangement were requested by Charles Ward Hall, and Igor Sikorsky asked for a more complete study of tandem propellers, of tandem propeller efficiency at cruising and top speed as well as the condition of static thrust. He also requested information on the proper position of tandem engines, gearings of engines, and propeller design, which factor he mentioned as considerably complicated by the variable pitch type of propeller as well as the cooling of air-cooled engines in tandem arrangement. Looking into the future, Mr. Sikorsky mentioned the possibility of complete cowling of tandem engines without direct cooling and utilizing the blower system, calling attention to the fact that, at high speed, it probably would be preferable to use power rather than parasite drag for this purpose. In this connection Mr. Miller informed the audience that it was the intention of the research workers to proceed with a study of tandem propellers in the wing-nacelle investigation just as soon as the biplane tests were completed. He added that the actual tandem study would be preceded by a consideration of pusher propeller installations.

Data on flying boat hulls equipped with sponsons was asked by Lessiter C. Milburn who suggested that information be sought on the form of flying boat body best suited to combine good spray characteristics with low water resistance. Regarding vibration, Mr. Milburn said that he believed its destructive effects should not be measured by amplitude and frequency, but that a more detailed investigation should be made to determine the causes. In reply to the question on hulls, Starr Truscott stated that, while the program of the new towing basin had not been finally determined, it included the questions brought up by Mr. Milburn. He added that a study of existing hull forms indicated the possibility of getting a fair combination of these two factors.

Data on fuel consumption at cruising speed and the ideal combination of propeller setting and other factors related to this problem were asked by Bruce G. Leighton. To this Mr. Kemper replied that this problem was one of the reasons for the construction of the hub dynamometer which had been shown to the audience earlier in the day and that the committee was also developing a fuel flow meter for such tests.

Admitting that engineers were running out of questions to ask the committee regarding research, Dr. Michael Watter requested a more precise definition of maneuverability, controllability, and stability and suggested a comprehensive study. Mr. Crowley responded that the laboratory was doing work on the maneuverability problem but was confining it to pursuit planes. He hoped, however, that by putting several of these through various maneuvers it would be possible to derive knowledge of the main factors entering into the problem.

Three commercial autogiros

The Pitcairn and Kellett machines,—a comparative study of their proportions and structure

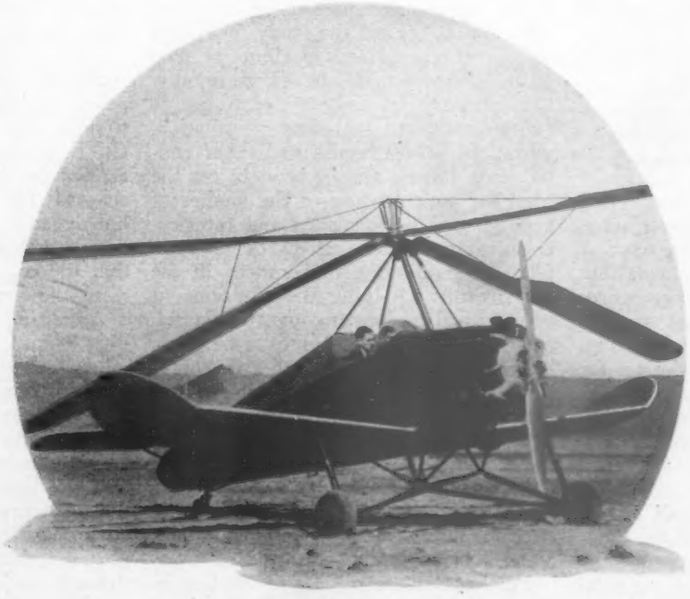
NO LONGER is the autogiro a seven days' wonder. It has become a commercial product. With the announcement of the Kellett two-seater, of which this is the first detailed release, there are two manufacturers definitely in the field, offering three standardized models at fixed prices. A third, the Buhl Aircraft Corporation, has taken a license, but has not as yet produced a machine. Up to the first of June eight Pitcairn machines, all of the PCA-2, 300-hp. models, had been built under an approved type certificate and delivered. An approved type certificate has been secured on the Kellett, and both that and the Kinner-powered Pitcairn are going into production in small lots. The major characteristics of all three models are tabulated in Table 1 on the page opposite.

The field is an open one. The Autogiro Company of America, holder of American rights under Senor de la Cierva's patents, has been prepared to give licenses to responsible applicants on fixed terms. A great deal of natural confusion has arisen out of the existence side by side of the Autogiro Company of America and Pitcairn Aircraft, Inc., autogiro builders. It is commonly assumed that they are intimately enmeshed with each other.

As a matter of fact, the two companies are very carefully kept separate, and make contact only through their common control by Harold F. Pitcairn, original American autogiro backer. They have no operating personnel in common, and the Pitcairn designs are now being prepared by the Pitcairn staff, headed by Walter C. Clayton as chief engineer, exactly as those of any other licensee might be.. The parent, patent-owning company gives its licensees advice where sought in matters of general principle, but it does not dictate their practices, nor does it engage in detail design work. Conspicuous in the personnel roster of the Autogiro Company, aside from Mr. Pitcairn himself, are: Geoffrey S. Childs, executive vice-president; E. T. Asplund, vice-president; Agnew E. Larsen, chief engineer; James G. Ray, better known to the aeronautical world than any of his associates for the spectacular demonstrations that he has provided at many eastern airports and aeronautical gatherings, vice-president and test pilot.

The appearance of the autogiro has become familiar in the northeastern states, and especially in the neighborhood of New York, Philadelphia, and Detroit. The general behavior of the type is well known, but the theory is still a profound mystery to most of the onlookers, even though they be qualified engineers and airplane designers. As they seek to understand it, their usual tendency has been to simplify it too much, to supply analogies that have no force, and casually to dismiss the essential features of the machine on the presumption that they represent merely the artistic taste of the designer.

Thus, one often hears it said that the



The Continental-powered Kellett

Two Pitcairn PCA-2s over New York Bay. Below: The Kinner-powered PAA-1

small fixed wings with upturned tips which extend out from the bottom of the fuselage have no function except the support of the ailerons. As a matter of fact, they are essential to proper operation. It is often assumed that the rotor is merely a pinwheel carried in ball bearings somewhere approximately above the center of gravity and on the plane of symmetry of the fuselage. As a matter of fact, its position and attitude and the proportioning of its parts, including the odd angles at which its axis is offset both longitudinally and laterally, have to be determined with the utmost nicety. They offer a dynamic problem for which there is no counterpart in airplane design. Aeronautical experts with a gift for epigram, watching the autogiro functioning, have summed it up in a phrase as "nothing more than an airplane in a continuous flat spin." No parallel could be more inexact. The essential characteristic of the flat spin is that the angle of attack is enormously large, far beyond the stall. One of the most essential characteristics of the autogiro's behavior is that the rotor blades are never stalled except on their innermost portions. The effective parts of the blade work, for all flight speeds and conditions, within a surprisingly narrow range of angles of attack.

There is no idea of giving an elaborate explanation of autogiro theory at this point, nor any explanation at all except insofar as it controls design characteristics and is necessary in order to understand design practice. A great part of the autogiro structure involves no general principles new to the airplane designer—power plant and mounting, fuselage, landing gear, tail surfaces, and surface controls.

Though all these elements are akin in name and in purpose to parts of an airplane, their detail design is of course affected by the fact that it is to an autogiro that they are being applied. The familiar constants and ratios developed through 25 years of airplane experience cannot be directly applied. A new body of experience is being collected, and a new set of design standards developed.

Thus, for example, there are small but conspicuous differences in the proportions of the fuselage and landing gear,

Table 1: Major characteristics of the two Pitcairn and Kellett autogiros

	Pitcairn PAA-1	Pitcairn PCA-2	Kellett
Gross weight (lb.)	1,750	3,000	2,200
Weight empty (lb.)	1,150	2,093	1,556
Maximum useful load (lb.)	600	907	644
Seating capacity	2	3	2
Engine	Kinner	Wright	Continental
Horsepower	125	300	165
Rotor diameter (ft.)	37	45	41
Weight per horsepower	14.0	10.0	13.3
Performance (reported by manufacturer)			
Maximum speed (m.p.h.)	92	123	....
Minimum speed of level flight (m.p.h.)	....	24.5	....
Rate of climb at sea level (ft. per min.)	....	1,000	....
Service ceiling	....	16,400	....
Vertical velocity for vertical landing in still air (ft. per sec.)	15	16	....

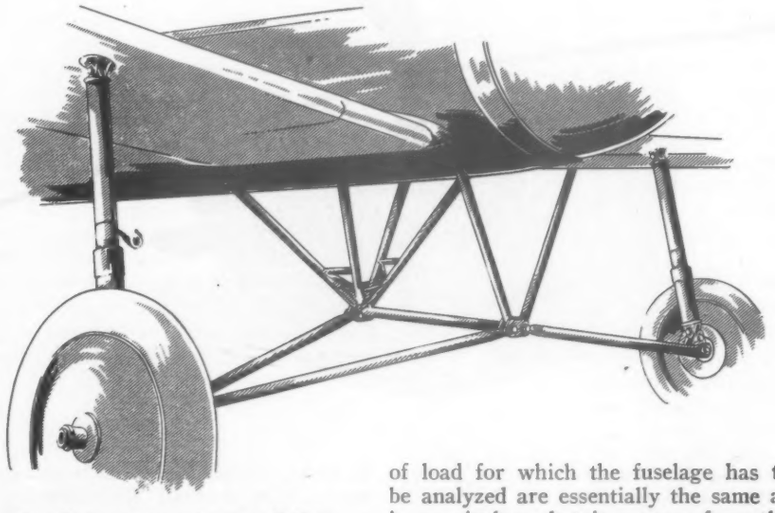
which form the foundation of an autogiro as they do an airplane. The fuselage seems short in proportion to other overall dimensions. In airplanes the distance from the center of gravity to the mean center of pressure of the horizontal tail surfaces ranges from 35 to 50 per cent of the wing span. Taking the diameter of the rotor of an autogiro as being equivalent to the wing span of an airplane, the distance from the center of gravity to the tail is 33 per cent of the diameter in the large Pitcairn machine, 31 for the small Pitcairn, and 29 in the Kellett. A factor affecting the length of the fuselage is the desire to keep the tail surfaces under the most effective working portion of the rotor blades, as the conditions of air flow there are at their best for the controls.

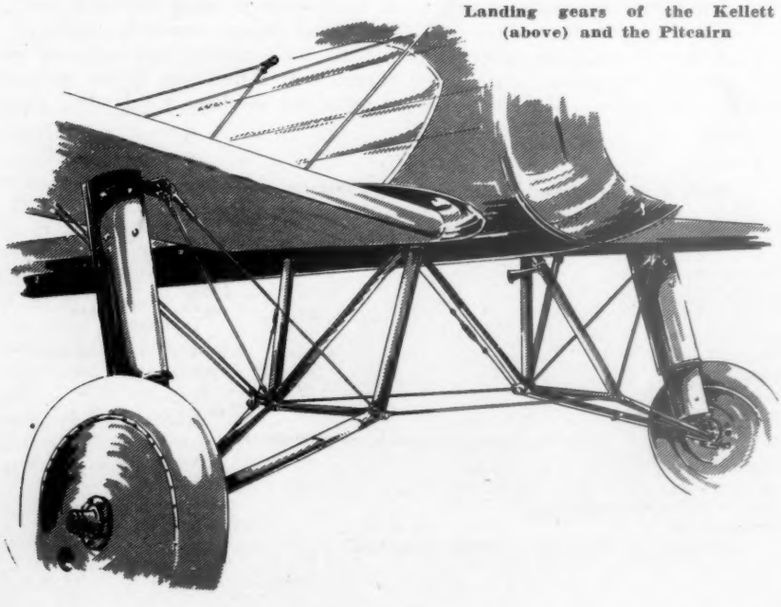
The fuselage in some cases has an odd appearance, due principally to the unusually small height and small aspect ratios of the vertical tail surfaces and to the use of a straight lower longeron, with the top line of the fuselage bent down sharply at its after end.

Rotor clearance provides the explanation of all these changes in form. To avoid dangerous vibrations and shocks it is essential that the suspension cables, which run from the rotor cone, or upward extension of the hub, down to a point midway along each blade, should always remain slack in flight. Rubber cords are attached to keep them just taunt enough to prevent them from flapping wildly. The cables must be long enough so that the changes in the inclination of the virtual rotor axis, or axis of the conical figure actually being described at any instant by the hinged blades, can be taken care of as flight conditions change without ever allowing the blade to "bottom" on the cables. On the other hand, it is very obvious that the rotor blades must never, either at rest upon the ground or in flight, be able to descend far enough to strike any part of the structure. In the original Cierva machines, built up around airplane fuselages, considerations of clearance required that the droop angles be kept very small. When the machine was at rest the rotor blades hung only 3 deg. below the plane perpendicular to the rotor axis. The maximum speed of flight was limited by the danger of bottoming the blades on the cables, rather than by engine power, since the inclination of the virtual rotor axis and the consequent dip of the blade below the horizontal plane at the lowest point of its orbit increases with increasing flight speeds. In recent designs that hazard has been overcome by bending the fuselage down towards the tail and by using a very low fin and rudder. In the Pitcairn machine, both the larger and smaller models, the angle of droop below the plane perpendicular to the rotor axis is 6½ deg., while in the Kellett it is 9. This allows a minimum clearance of about 10 to 12 in. between the rotor blades and the top of the fin or the tip of the propeller. The clearance over the tail has to be large enough to allow not only for the stretch of the suspension cables but also for the deflection of the very flexible rotor blades near their tips, which may amount to 5 or 6 in. in extreme cases.

Aside from their exterior form in profile there is nothing remarkable about the fuselages of any of the machines. The seating arrangements are normal, those in the two Pitcairn models having the two cockpits in tandem, with the forward cockpit accommodating two passengers in the 300-hp. machine, while in the Kellett the two seats are side by side in a single cockpit.

The fuselage structure, like the seating arrangement, is in strict accordance with airplane practice, being of steel tubes assembled by welding. The complete fuselage of the large Pitcairn machine weighs 242 lb., 11.3 per cent of the total weight empty. In the Kellett the corresponding figures are 161 lb. and 10.1 per cent, the averages of these percentages being a little lower than is customary airplane practice. The types of load for which the fuselage has to be analyzed are essentially the same as in an airplane, but it appears from the studies made by the Autogiro Company's engineers that the tail surface loads can be considerably lower. Thus, a machine of the characteristics of the large Pitcairn has only to be designed, according to the experiments that have been made and the conclusions drawn therefrom, for a total load on the horizontal tail surfaces of about 750 lb. A typical airplane of the same gross weight and maximum speed would be figured for about 1,200 lb.





Landing gears of the Kellett (above) and the Pitcairn

Landing gear design

Autogiro landing gears, like fuselages, show only small departures from those of the airplane in form and none in construction. The most characteristic features are an exceptionally large shock-absorber travel to take the impact of vertical landing and a very wide tread to guard against rolling over in landings made while drifting sideways, and

Table 2: Control surface ratios

	Pitcairn PAA-1	Pitcairn PCA-2	Kellett
Rotor disc area	1,075	1,590	1,320
Stabilizer area	9.1	15.9	14.2
Elevator area	13.0	19.2	22.8
Total horizontal tail surface area	22.1	35.1	37.0
Fin area	3.6	7.75	5.1
Rudder area	5.3	7.5	7.65
Total vertical tail surface area	8.9	15.25	12.75
Aileron area	15.1	28.2	23.4
Horizontal tail surface / Rotor disc	.021	.022	.028
Vertical control surface / Rotor disc	.008	.010	.010
Aileron / Rotor disc	.014	.013	.018

with not enough forward speed to give control. The shock absorption is of course provided by oleo struts, giving a maximum travel of 10 in. in the Kellett machine, of 8¼ in. in the small Pitcairn and 10½ in. in the large Pitcairn. The struts are of special design, the orifices for the passage of oil being traversed by tapered metering pins. The available area of orifice is thus decreased in the latter part of the stroke of the oleo, and the pressure during landing is more nearly constant than with a long stroke strut and a free orifice. The shock absorbers are assisted in their work by medium pressure tires on rims of 10-in. base diameter, the diameter of the casing ranging from 6.5 to 8.5 in. The actual tread figures are 13 ft. 3 in. in the large Pitcairn machine, 12 ft. in the Kellett, and 10 ft. in the small Pitcairn. The fore and aft position of the landing gear is determined essentially as in an airplane, a line from the axle through the center of gravity making an angle of about 12 deg. with a perpendicular to the axis of the fuselage. The landing angle is also normal by airplane standards, ranging from 11 to 14 deg. when referred to the fuselage axis as the datum line (angle between the fuselage axis and the line connecting the wheels and tail skid).

The landing gears of the Kellett and Pitcairn models are quite different in design. The former is, except for the wide tread, essentially an orthodox raised-axle airplane gear. The shock absorber struts, inclined slightly inward from the vertical, are attached to the front spar of the fixed wing. There are no wires in the landing gear. In the Pitcairn models, on the other hand, wires are omnipresent. The two sides of the landing gear are quite independent, being tied together only by two streamline wires, 6 ft. in length, running transversely about 24 in. above the ground. The truss is essentially like that of some high-speed twin-float seaplanes, in which the float support is used as an important element of the wing bracing. The arrangements of both landing gears are shown in sketches on page 410. In the larger of the two Pitcairn models the shock absorber struts are vertical, but in the small one they are inclined inward at an angle of about 30 deg. to the vertical.

Brakes are furnished as standard equipment in all the autogiros now on the market. The Pitcairn models have tail skids of normal airplane form sprung by rubber cords, but with about 50 per cent more travel than would be customary in an airplane. The Kellett uses a tail wheel supported on an oleo strut.

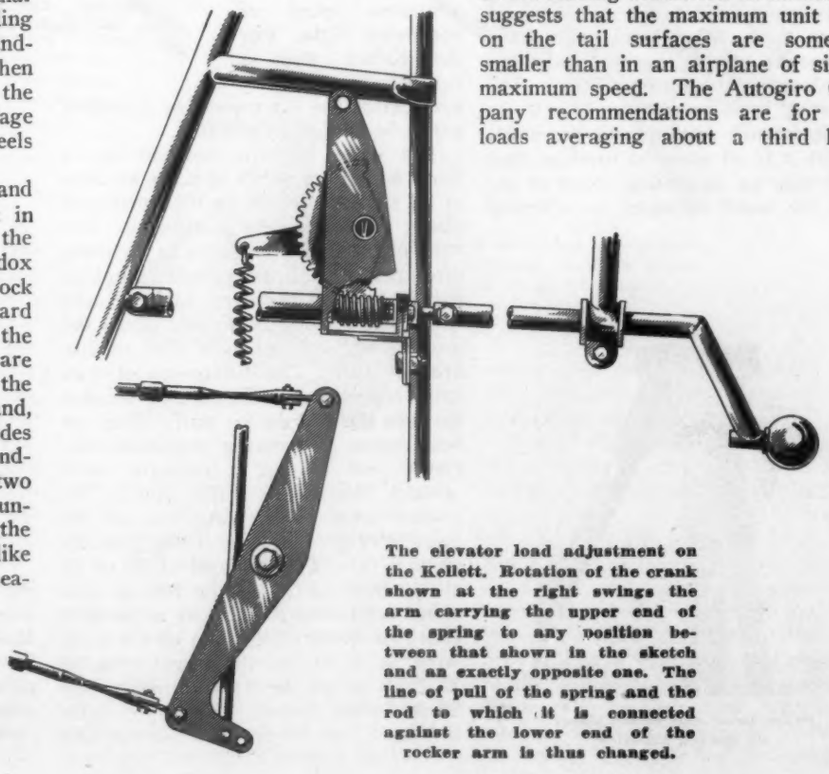
Characteristics of tail surfaces

Among the distinctive features of the autogiro tail surfaces, the small aspect ratio of the fin and rudder has already been mentioned. Another is the large size of the elevators in relation to the stabilizer, the elevators comprising on the average about 55 to 65 per cent of the horizontal tail surface instead of the 35 to 45 per cent which is common airplane practice. The explanation is found in the very low minimum speed and in the necessity of a powerful longitudinal control to take effect under those conditions. The same factor, together with the variable angle at which the downwash of the rotor strikes the tail surfaces, accounts for the use of an exceptionally large range of angular movement of the elevator. In the Pitcairn models, for example, the maximum control of the elevator is 40 deg. either way from this position. The total throw on the Kellett is about 10 per cent less. The large Pitcairn employs a simple variable-gear control, such as has been used on some racing planes, to give a less sensitive longitudinal control at high speeds when the stick is near its neutral position. The two smaller machines have nothing of the sort.

Autogiro design practices are hardly well enough established to determine the basis upon which control surface area ratios or constants should be specified. From the basic theory, however, it appears that the total disc area of the rotor is the best point of departure. Using that as a criterion the control constants can be calculated, and they are included in Table 2. It will be observed that the horizontal and vertical tail surface and aileron areas are in about the same ratio to each other as in a typical airplane, and that the ratio of control surface areas to rotor disc area is approximately one-fifth of the ratio of the same surfaces to the wing area in a modern plane.

In the Kellett machine the tail surfaces are of wood; in the Pitcairn models of welded steel construction.

As has already been noted, analysis of the loading conditions of an autogiro suggests that the maximum unit loads on the tail surfaces are somewhat smaller than in an airplane of similar maximum speed. The Autogiro Company recommendations are for unit loads averaging about a third lower



The elevator load adjustment on the Kellett. Rotation of the crank shown at the right swings the arm carrying the upper end of the spring to any position between that shown in the sketch and an exactly opposite one. The line of pull of the spring and the rod to which it is connected against the lower end of the rocker arm is thus changed.

than in an airplane of like size and performance.

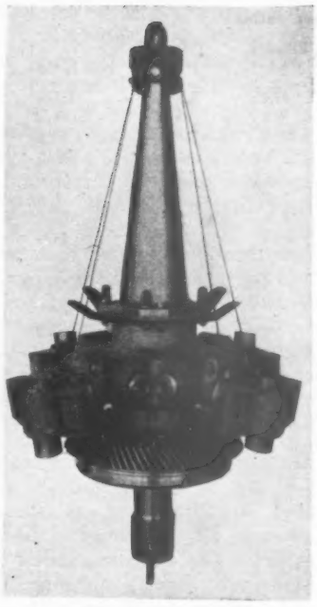
The Pitcairn machines have a normal stabilizer adjustment controlable from the rear cockpit. The range is from 0 deg. to plus 4 deg. to the fuselage axis.

The designers of the Kellett machine have adopted an alternative arrangement for the adjustment of longitudinal balance. The stabilizer is fixed, but the control system incorporates a highly specialized type of adjustable bungee, best to be understood by reference to the drawings on page 411. It differs from an ordinary straight bungee in that the moment arm at which the spring works increases as the displacement of the controls are increased. In case the adjustment is set to pull the stick back, for example, giving the effect of tail heaviness, the forces is very small when the stick is near its central position and gets steadily larger as it is allowed to come farther and farther back. The adjustment thus serves at once the purposes of an adjustable stabilizer and of a balanced control system.

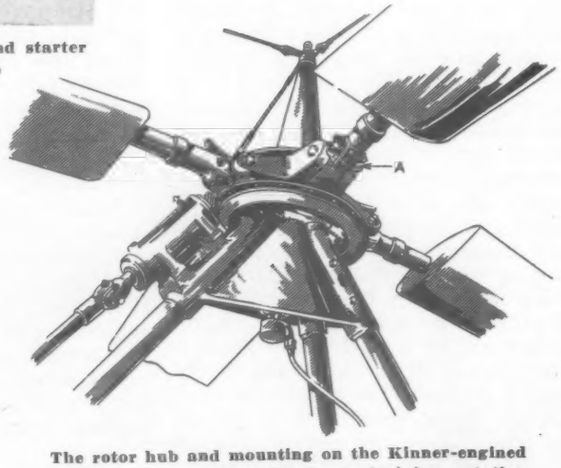
There remain for consideration the parts peculiar to an autogiro, the fixed wing and the rotor and its mounting and control.

Function of fixed wing

As has already been suggested, the proportions of the fixed wing, small though it is, have a very definite effect upon performance. Were it not for the fixed surface the rotor speed would vary excessively with speed of flight, increasing at high speed and decreasing at low. An imperfect adjustment of the fixed surfaces, on the other hand, might have the opposite effect, the rotor slowing down dangerously during a dive. The fixed wing is so proportioned, as to its area, its airfoil section, and the angle at which it is set upon the fuselage, that it will take an increasing share of the lift as the speed increases, so relieving the load on the rotor and making it possible for it to continue to do its share without change of speed. The Autogiro Company's estimate of the part of the total load carried by the fixed wing for a machine of the Pitcairn's proportions is 23 per cent at maximum speed, dropping off to 8 per cent at minimum speed of horizontal flight. For the Kellett with a considerably larger fixed wing, the corresponding estimates would be 32 and 14 per cent.



The hub assembly and starter gear complete



The rotor hub and mounting on the Kinner-engined Pitcairn. The rubber blocks restraining rotation of the blade around the vertical hinge pin are inserted at A.

Pylon head and brake shoes on the big Pitcairn

The rotor hub's foundation element, with bushings for the horizontal hinge pins in place

The large Pitcairn machine has a fixed wing area of 90 sq.ft. or an area of 88 sq.ft. projected on the horizontal plane. This includes the ailerons. The ratio of the fixed wing area to the rotor disc area is .055. The smaller Pitcairn has 52 sq.ft. in the wing, and the area ratio is .048. In the Kellett model the area of 100 sq.ft. gives a ratio to disc area of .076. The differences of area ratio represent a difference of opinion between the two design staffs about the best means of securing maximum efficiency and keeping a constant rotor speed. The models differ also in the general form of the wing, that on the large Pitcairn machine being sharply tapered from a root chord of 52 in. to a tip chord of 30 on the 300-hp. machine, while the Kellett has a constant chord of 54 in. The span of the fixed wing is 30 ft. on the large Pitcairn, 22 ft. 9 in. on the small Pitcairn, and 26 ft. on the Kellett. The aspect ratio is from 8.7 to 9.4 on the Pitcairns, and this value is only 5.2 on the Kellett.

The wing of course has the responsibility of providing lateral stability in a sideslip, and it must act promptly, to bring the tip up in case a slip starts with very low forward speed and correspondingly ineffective control. It should serve also to give a proper bank in going suddenly into a turn of high speed, compensating for the lack of high fin area and the consequent tendency of the machine to start to bank in the wrong direction as the result of skidding when the rudder is sharply applied. As in an airplane, dihedral is the obvious expedient in such a case, and it has been generously employed—5 deg. in all cases, with about 2 ft. of either tip turning up another 35 deg.

The wing structure, serving as an anchorage for the landing gear and taking the full landing impact through the shock-absorber thrust at a distance of about 5 ft. from the wing root, is made very solid. It is rigidly braced at the point of landing gear attachment, by wires in the Pitcairn and by diagonal struts from the upper longerons in the

Kellett, and cantilevered beyond that point. The structure is simply that of an airplane wing, a wooden skeleton covered with fabric. The weight of the wings, including ailerons and external bracing members makes up an average of about 6½ per cent of the total weight empty. The load factors for which the fixed wing is designed are similar to or a little above those ordinarily required for the wings of commercial airplanes.

Even the fixed wing has a close analogy in the airplane, but in examining the rotor we arrive on wholly new ground. There is nothing about its detail, except for the use of an airfoil section in the blade, to suggest the older and better-known type of heavier-than-air craft.

The rotor assembly in general

To summarize very briefly what is common to all existing autogiros, the rotor is an assembly of four blades hinged to a hub which turns freely on a shaft. It is carried by three S.K.F. ball bearings, two pure radials and one of radial thrust or angular-contact type. The shaft is mounted on top of a pylon of three steel tubes, spreading out from the base of the shaft to their well-separated points of attachment on the fuselage. Although the rotor normally turns freely, and always does so when in flight, it, with its mounting on the pylon, is subjected to torque in both directions under special conditions. The positive torque is applied by the mechanical starter, of which more later; the negative torque by the brake used to bring the rotor to rest after landing.

The rotor blades are set at a static angle of only about 2 deg. to their direction of travel when the machine is at rest. As the blade is built around a single spar, however, its torsional rigidity is limited, and the effective angle is increased approximately from 2 deg. to 4 by blade torsion. The actual angle of attack of a blade element in flight is further increased by the fact that the rotor as a whole is at a positive angle to the flight path when in normal flight. The elements on the outer third of the blade actually work at angles of attack ranging from 6 or 7 deg. in vertical descent down to about 4 deg. at maximum speed.

It is undesirable to set the rotor at a large angle to the fuselage because of the tail clearance difficulties already described. The rotor axis is inclined slightly back of a perpendicular to the fuselage axis. The engine of an autogiro is given a downward tilt of about 6 deg. in order to bring the thrust-line through the C.G. to improve longitudinal stability.

The rotor blades are of course very narrow and of high aspect ratio, and occupy only a small part of the disc swept by the rotor. The actual ratio of blade area to disc area is called the "solidity," and is approximately .1 in all cases.

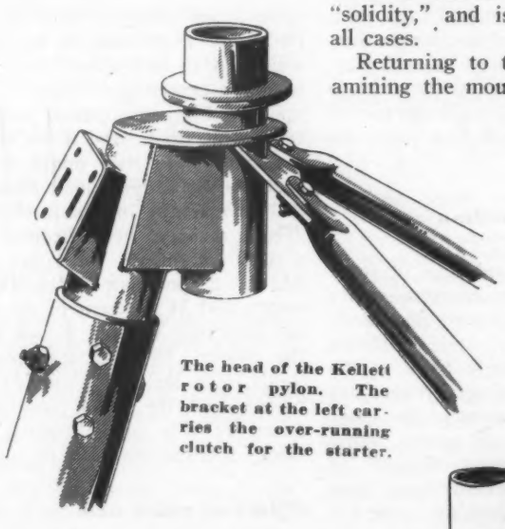
Returning to the rotor hub and examining the mounting of the blades in more detail, they are found to be connected to the hub through a Hooke's universal joint, and so restrained by wires and elastic members as to have only a limited freedom. Suspension cables run, as already noted in connection with the fuselage proportions, from the top of the rotor cone to a point about 9 ft. out of each blade. Another set of wires, attached a little further out on the blades, pass from blade to blade to prevent the angles between them from changing too much from the normal 90 deg. A further restraint against oscillation of the blades in the rotor plane ("plane" in this connection is of course only an approximate term, as the rotor blades are normally describing a very flat conical surface at all times) is provided by blocks of rubber so fitted into the blade attachment as to resist any movement about the vertical hinge-pin of the universal-joint attachment.

The rotor hub brings into the picture another company, the last of the autogiro group. The Autogiro Specialties Company has been formed by Mr. Pitcairn, with Mr. Joseph Pecker, well-known Philadelphian consulting engineer in direct charge of design as chief engineer, to supply to autogiro licensees those parts that can be best made in a precision machine shop. The outstanding example is of course the rotor hub. Both Pitcairn and Kellett companies secure their hubs and their rotor starting mechanisms from the Autogiro Specialties Company's plant.

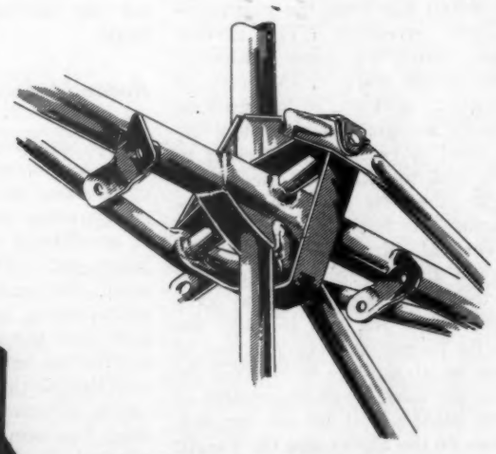
The hub is so designed as to permit the removal of the rotor as a whole, including all suspension cables and bearings. Instead of pulling the bearings off the axle when the rotor is to be lifted, the axle itself is taken along as a part of the unit and reassembly is accomplished by inserting the projecting lower end of the axle into a tube about 5 in. in length which forms a rigid part of the pylon assembly, and securing it there with a nut and turned-down washer, much as a propeller is held on its shaft. The axle for the small Pit-

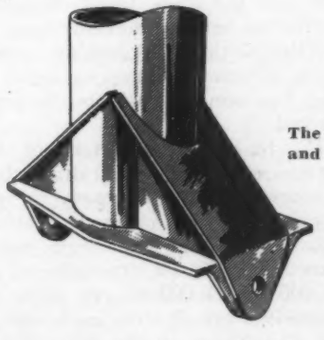
Table 3—The rotor blades

	Pitcairn PAA-1	Pitcairn PCA-2	Kellett
Rotor diameter (ft.)	37	45	41
Rotor disc area	1,075	1,590	1,320
Rotor blade area	108	137	133
Coefficient of solidity	.100	.098	.107
Normal rotor r.p.m.	145	135	133



The head of the Kellett rotor pylon. The bracket at the left carries the over-running clutch for the starter.





The lower end of the Kellett pylon and a sketch to show its attachment to the fuselage.

cairn and the Kellett, is 2 in. in diameter; the overall height of the hub, 23 in. from the top of the rotor cone to the bottom of the axle. The portion of the shaft on which the bearings are carried is a little less than 6 in. in length. The radial thrust bearing is uppermost, resting against a $\frac{3}{16}$-in. shoulder on the shaft, with a radial bearing immediately below and another one 4 in. farther down. The rotor cone, which is an aluminum alloy casting, supports the upper end of the tachometer drive shaft and has an eye for the attachment of a hoisting sling, in addition to carrying the inner ends of the suspension cables.

The hinging of the rotor blades at their inner ends has three main purposes, the reduction of stresses in the blade, the elimination of gyroscopic phenomena, and the stabilizing of the autogiro. All three factors operate to require hinging about a horizontal axis, and without the use of horizontal hinge-pins the operation of the autogiro would be quite impossible. The lift on one blade being much more than on the other, because of their difference in absolute velocity through the air when the machine is moving forward, the machine would promptly roll over sideways, and even without that difficulty it would be the prey of the natural instability which has been the nightmare of helicopter inventors. The vertical hinge pin, permitting some motion of the blades in the plane of the rotor, is not an essential, and was in fact missing in the early autogiros, but is now invariably used to reduce the stresses in the blade and to eliminate the torque that might otherwise have to be transmitted across the hub.

The vertical hinge-pin has to be placed some distance off the rotor axis in order that centrifugal force may have a moment about the pin to hold the blade to its proper relative position in the plane of rotation. If the pin be too far in, the blades will be unstable in their own plane; if it be too far out, the stresses on the blades and the weight both of the blade and of its mountings will be increased. In the Pitcairn machines the radius is $7\frac{3}{4}$ in. in the large model, and 4 in. in the small one. In the Kellett it is $6\frac{1}{4}$ in.

In the case of the horizontal pins, the offset from the axis is the minimum compatible with mechanical convenience —$3\frac{3}{8}$ in. on the PCA-2, $2\frac{3}{4}$ in. on the other types.

Attachment of blades

The attachment of each blade to the hub thus calls for three main parts, two hinge-pins and a block having two holes at right angles to each other and about 1 to 3 in. apart. The block, which is the intermediate member, fits at its inner end into a $2\frac{1}{4}$ in. fork on the hub that takes the horizontal hinge pin, while at its outer end it extends between the jaws of a fork about $1\frac{3}{8}$ in. wide, mounted on the inner end of the main spar of the blade and taking the vertical pin. The hinge-pins, about 1 in. in diameter, are carried in bronze bushings. They are hollow, packed with grease and equipped with Zerk lubricator fittings, and are held in place by $\frac{5}{16}$-in. through-bolts.

The inter-blade cables themselves contain another yielding element in the form of pieces of light shock-absorber cord which gather up a loop in each cable and permit about 10 in. of stretch before the cable comes taut. The principal purpose of that, however, is to allow for the change of distance between the blades as the coning angle changes. The cables are attached at their ends to another and more effective shock-absorber, a small Houdaille hydraulic unit similar to those used on automobiles. Such a unit, with a cylinder about $2\frac{1}{4}$ in. in diameter and an arm about 8 in. long extending along the surface of the blade to take the cables, is mounted in each blade, fixed to the tubular spar of the blade by clamping. The maximum displacement of the point of cable attachments relative to the surface of the blade is about 4 in. each way. These units are absolutely identical in the Pitcairn and Kellett machines except for the method of insertion into the blade.

Rotor blade construction

The fundamental conditions of rotor blade construction are extreme nicety of balance, accuracy of weight control, comparative flexibility, and simplicity of attachment to a single point at the inner end. The bending stresses are small, the bending moment at the inner end (where hinged) of course being zero and the blade being "floated" in equilibrium between the centrifugal force and the air load. Assembly around a single structural element, a round steel tube, has been the solution universally adapted.

The lone spar is a tube of 4130x chrome molybdenum steel drawn by the Summerill Tubing Company to special specifications very narrowly controlling uniformity of gage and weight, and heat treated to ultimate strengths of from 125,000 to 180,000 lb. per sq.in. The dimensions are $2\frac{1}{4}$x.058 in. in the Kellett, $2\frac{1}{8}$x.083 in. in the large Pitcairn, and $1\frac{1}{4}$x.058 in. in the small Pitcairn. Into the inner end of the main tube is pinned the fitting which in turn holds the yoke that takes the vertical hinge-pin and connects to the hub-attachment universal-joint block. The yoke is locked in place in the fitting by a thread, and carries a segment of a worm wheel which is engaged by a $\frac{1}{2}$-in. worm carried on the blade. A very delicate adjustment of the incidence of the blade is thus provided for. The adjustment is made at the factory after flight trials and is intended to be permanent, never requiring rearrangement in the field. A very delicate control is in fact necessary, for if the angle be changed as much as 5 min. of arc from the correct value it will cause the blades to run very evidently out of track with each other.

The ribs of the blade are of wood spaced from 3 to 4 in. apart, and each attached to a metal collar fitted over the tubular spar. In the Pitcairn machines the collars are soldered in place, while in the Kellett design they are secured by $\frac{1}{8}$-in. clevis pins passing through the tube. Over the forward part of the blade, extending back to a little behind the tubular spar, the airfoil section is defined by plywood covering. The section, incidentally, is a Gottingen 429, a symmetrical bi-convex form. The trailing edge of the blade is formed by a vee-shaped strip of stainless steel, containing several telescoping joints in its length so that it cannot be crumpled up by the bending of the blade in its own plane. The covering is airplane fabric.

The rotor is the heaviest single element of an autogiro structure, as it is the most important to operation. Its weight is in fact essential to its working, for centrifugal force is depended upon to keep the coning angle within reasonable limits, and if the blades were made too light they might rise unduly high above the horizontal plane. In the Kellett machine the rotor blades weigh 278 lb., and the hub and cone 54, making a total weight for the rotor proper of 332 lb., 22 per cent of the total weight empty and 34 per cent of the weight of the structure without power plant. In the 300-hp. Pitcairn the rotor weight totals 400 lb., including 315 in the blades, and the pylon contributes another 52. The small Pitcairn has rotor blades totaling only 176 lb.

Offset of rotor axis

As the advancing blade of the rotor carries more lift than the receding one, it might then be expected that the high point of the rotor would be on the side of the advancing blade, but actually, due to the inertia of the blades, the high point is reached some 30 deg. after passing the forward position. The low point is similarly reached shortly after the blade passes over the tail and begins to advance. Either an angular or a linear offset of the rotor axis is necessary to keep the machines from being right-wing heavy, since the horizontal hinge-pins do not exactly coincide with the axis of rotation but are offset a few inches. The tilt of the virtual axis of the rotor would permit the blades to impose on the hub, and so ultimately on the fuselage, a centrifugal couple tending to tilt the whole machine to an axis in alignment to that which the rotor had selected for itself.

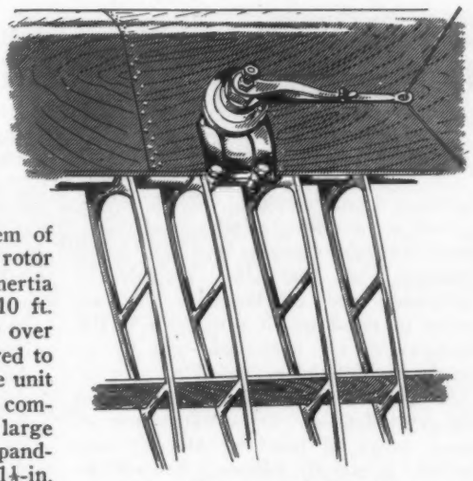
It is upon the equalization of this offset couple that American design practice varies most widely. The earliest of the commercial models, the 300-hp. Pitcairn, has the rotor axis tilted 2 deg. 30 min., (leaning to the left at its upper end) and with no lateral offset. In other words, the tilted rotor axis intersects the plane of symmetry of the fuselage in the plane of the attachment to the rotor blade. In the new Pitcairn a combination of angular and linear offset is used with very satisfactory results, the shaft being tilted 1 deg. and also set over 1 in. to the right from the line of symmetry. The Kellett, last of the three to be completed, abandoned the linear shift of the axis, but uses a larger angle of transverse tilt than any of its predecessors,—3 deg. 35 min.

The pylon, upon the apex of which the rotor fits, is itself crowned by the fixed element of the brake. To appreciate the magnitude of the problem of braking, let it be realized that the rotor of the 300-hp. autogiro has an inertia equivalent to that of a flywheel 10 ft. in diameter and weighing slightly over a ton, and that the brake is required to bring it to rest within 30 sec. The unit was worked out by the Bendix company, and the final solution for the large machine is a two-shoe internal-expanding brake with 8-in. diameter and 1½-in. face. On the smaller Pitcairn ship the diameter is only 6 in.

Starting the rotor

The converse of the problem of braking is that of starting the rotor. On the large Pitcairn machine a power input of 40 hp. is required to get the rotor up to speed within 30 sec. The starter as now used begins with a take-off of the drive from the engine at the point where an inertia starter drive would normally be attached. The engine itself is started with a Heywood gas starter. The unit attached directly to the engine contains a pair of spiral bevel gears turning the drive through a 60-deg. angle, and a single disc clutch controlled by a lever in the pilot's cockpit. This clutch is designed to slip when picking up the load, the maximum torque transmitted being definitely limited,—a necessary feature, as the engine continues to turn at constant speed while the rotor is picking up from 0 to 125 r.p.m. From this point the starting power is transmitted through a 1-in. tube running parallel to and slightly forward of the foremost member of the pylon structure. The torque tube has a universal at each end and a telescoping joint within its own length to allow for flexibility in the structure.

At the upper end of the tube is a cylindrical box, about 9 in. long and 3½ in. in diameter, shown in the sketch of the rotor hub and mounting. It contains an over-running clutch which prevents the engine from acting as a brake on the rotor. As soon as the aerodynamic forces are able to keep the rotor turning at a speed greater than that at which the engine was driving it the over-running device becomes effective and the connection between the engine and the rotor is substantially broken, even if the pilot should forget to disengage the starter clutch. Just above the over-running clutch the starter drive terminates in a spiral bevel pinion, about 1 in. in diameter, meshing with a spiral bevel ring gear mounted around the rotor brake drum. The complete starter, including everything from the attachment to the engine to the ring gear about the brake drum, weighs about 52 lb.



Rotor blade construction in the Pitcairn models and mounting of the shock absorber for the interblade cables. The two straps running around the blade spar and clamping the shock absorber cylinder in place will be noted.

Starter and brake are both under the pilot's control. As a safeguard against absent-mindedness they are interlocked to prevent the starter being thrown in while the brake is on. In the smaller Pitcairn model that is accomplished by having a single lever on the left side of the cockpit pulled back from its neutral position to apply the brake and thrust forward to start the rotor. In the Kellett there are two separate levers, but there is a mechanical interlock so that the starter lever cannot be moved except when the brake lever is in the off position, and vice versa.

In rotor hub and in starter and brake all the machines are virtually identical, but in the construction of the pylon there are notable differences. In all cases the basic structure is of three tubes. In the Pitcairn all three are of about equal size, and enter at their upper ends into socket fittings in which they are pinned to give some flexural rigidity. The torsion on the pylon head due to starting and braking is taken by bending and torsion in the individual tubes and by the fact that they are anchored in the head at points several inches apart. The head itself is of chrome molybdenum steel casting in the large model, a welded steel assembly, reinforced by gusset plates across between the three sockets in the small one.

The pylon on the Kellett is so designed that the loads are apportioned among the members in a more definitely calculable manner. In terms of automobile experience, the Pitcairn presents an analogy with the well-known Hotchkiss drive, torque being carried as an incidental function by members already existing in essentially the same form for another purpose. The Kellett design is more like that of a car with a separate torque tube. In it, all the torsional stresses on the head are carried through a 3-in. tube of heat-treated chrome molybdenum steel and of .083-in. wall. The upper end of the tube is pinned very solidly into a socket in the pylon head to eliminate all torsional freedom at that point. The lower end terminates, as shown in one of the sketches published herewith, in a fork about 6 in. wide secured by a clevis pin to a truss built into the fuselage for the express purpose of supporting the pylon reaction. The pin runs perpendicular to the axis of the tube and in a generally longitudinal direction, so that the tube is very rigidly restrained against motion fore and aft or torsion, but is completely free to swing from side to side.

All torsional loads are therefore carried at that point. Transverse loads are supported by two much lighter tubes of 1¼ in. diameter and .049 in. gage, running from bracing points on the upper longerons and meeting on a lug at the rear end of the pylon head. They are attached to the lug by flattening and splitting their ends and using clevis pins, as in common landing gear and interplane strut practice. The pylon head in the Kellett machine, like that in the small Pitcairn, is built up by welding.

Power plant design

There is little more to be said. The power plant, left until the end for treatment, is of standard airplane type, and is modified only in the attachment already described of the rotor starter drive. Fuel and lubricating systems, engine control, and fire wall are all as in the airplane. The propeller is also normal, of the detachable-blade metal type, although set for somewhat less pitch than is customary in airplane work. The exceptionally wide speed range, and in particular the large difference between the speed of maximum climb and that of maximum rate of horizontal travel, of course complicates the propeller problem, and makes a controllable-pitch propeller a particularly attractive prospect.

The Chamber's safety conference project

An important step towards a worthy goal

INCREASED safety in all aspects of aviation has been a special goal for the Aeronautical Chamber of Commerce in recent months. Prodded on by occasional alarming accidents, various sections of the Chamber have given much attention to the establishment of practices which would increase the margin of safety and, as a result, a permanent safety conference to include all sections of the Chamber is being formed and a code of good practices has been prepared.

This concerted effort by the industry to provide sensible and careful methods of going about its daily tasks has a twofold purpose. Its chief aim is to lessen the loss of life and property. It also seeks to relieve the burden of costly insurance coverage, through the establishment of an improved safety record. It is thus an attempt to set its house in order for the good of all concerned and for the good of its personal pocket book.

The Safety Conference, to be organized by July 1, will be composed of one delegate from each member company. Because of the size of the conference, an executive committee will be appointed to handle certain aspects of its operations. The plan for the conference and draft of the safety code were prepared by individuals representing various sections and were approved by the Chamber's executive committee, a group which includes all past presidents of the organization.

The code is expected to achieve its end largely through emphasis on the various risks and the means of correcting or avoiding them. As the Chamber points out, the rules call for merely common sense conduct. They would stimulate the taking of additional pains, more thorough training and more rigid training, so that the margin of ignorance and carelessness—the two states of mind which provide a fertile background for accidents—will be as nearly annihilated as possible.

In another sense the code serves as the crystallization of the experience of many years of handling aircraft materials. If strictly followed, it would be practically impossible for any usual accident to occur. Each warning or recommendation has emerged from the severe laboratory of service operations in which the lives and livelihood of the individuals associated with an aviation enterprise are directly involved. It thus provides a definite, dependable and practical guide for the industry to follow.

The code at present is concerned principally with the problem of fire protection at airports. Though more varieties of opportunities for accidents exist at airports than anywhere else in aviation, it would seem that manufacturing plants should rank as a fairly close second. Probably their shop hazards will come in for special attention later. However, in the meantime the manufacturers are merely asked to observe closely the Department of Commerce airworthiness requirements in the production of aircraft and are referred to well established shop practices in the older metal, woodworking, and automotive industries. Various aspects of operations receive second largest attention while recommendations governing repairs and inspections are similar in extent and nature to the precepts for manufacturers.

As is to be expected, many of the recommended practices have a familiar ring. For instance, doping and painting in storage hangars should be limited to patching only, and this work should be done near a hangar door as far as possible from doors leading to the repair shop and rooms where there are open flames. The recommendation that during this doping or painting at least one man with two extinguishers should stand by is not as familiar, nor is the suggestion that privately owned cars and tractors not be parked inside hangars.

Emphasis is placed on good housekeeping around the airport. The day of the corner pile of airplane remnants and the indiscriminate storage of new parts and equipment in most ports has passed. Handling of fuel and lubricants should be in accordance with the practices worked out by the Fuel and Lubricants Section of the Chamber and announced some time ago.

An example of the code are the precautions to be taken in welding operations: (1) Draining and thorough ventilation of all gasoline and oil from tanks and system; (2) Removal of fabric and wood for a good distance back from spot to be welded; (3) Wrapping of all metal adjacent to the weld with wet rags; (4) Protection with asbestos blankets to prevent ignition inside plane or outside from molten globules of metal sparks; (5) When feasible, part to be welded should be removed from plane.

The code is at present in a proposed form and is admitted to be by no means complete. It will be the chief medium of expression on the part of the safety conference and, therefore, will be in a state of constant improvement in accordance with changing conditions and in the light of increased knowledge. As now constituted it represents a timely and valuable step toward the goal it seeks and it deserves the respect and loyalty of all units of the industry.

The sprinkler tests at the Bureau of Standards, Washington, in 1930, in the interest of airport safety

Flying versus transportation

Two years ago one of our best known passenger lines was started under the impression that the public was going to swarm into its planes.

By Capt. Frank T. Courtney

THE general public does not want to fly and probably never will want to. About two years ago one of our best known air passenger lines was started under the impression that the public was going to swarm into its planes; but nothing of the sort happened. A reduction in rates tempted a few more people into the sky. It was an interesting experiment, but it only let the red ink flow in through a different hole, and a prominent executive groaned despairingly that he had come to the conclusion that the public did not want to fly. His conclusions were correct, but his groans were unwarranted. Nobody wants to go for a train ride, but millions travel by trains as a means of getting somewhere. Ocean liners carry thousands of seasick, miserable beings who hate the sea but, like the renowned chicken, merely want to get to the other side.

The only real commodity that aviation has to sell is very rapid transportation. Over routes where surface transportation is excessively slow, mere flying automatically becomes rapid transport, but where aviation has to compete with highly efficient surface transport (which is all this article is concerned with) it is useless to try to sell mere flying. All sorts of reasons are given why the public does not fly: expense, danger, unreliability, airsickness, and discomfort. But these are only details.

The real trouble is that air transportation is so imperfect at present that it does not supply a public want. That is, it does not supply a service to the public worth the price it would be compelled to charge in order to make a reasonable profit. The operator, whether he realizes it or not, still continues to try to sell flying, which is partly the result, and partly the cause, of the imperfections of the passenger services. It is a result because some operators, unable to offer a convincingly sound argument on the grounds of rapid transport alone, work into their advertising much that is merely an invitation to fly. It is a cause because the operator, honestly believing that he is managing his airline as efficiently as possible, has come to believe that his main task is not to improve the efficiency of his service, but to "educate the public to fly." Hence he is wasting his substance in trying to induce the public to buy an unwanted article, instead of spending his money on making that article so efficient as to become a necessity. If this is not true, why do so many aviation people, well educated in flying, travel by train when they could be traveling by air?

The present volume of air passenger traffic is interesting, and its gradual increase even more interesting, but it is still far from being a paying proposition, and cannot compare with the days which I believe are coming, when almost all first class passenger traffic will go by air.

The problem of cost

In a commercial undertaking the question of costs is paramount. In this industry it seems to receive the most casual treatment, in both construction and operation. First and foremost it

Efficiency and economy are being sacrificed today on the high altar of Speed. Captain Courtney's long association with transport problems makes his analysis particularly pertinent at this time when operators are seeking every possible means to stem the tide of red ink.

seems to be insufficiently realized how closely costs are bound up with speed, for in every form of transportation, costs increase rapidly with speed. A couple of knots increase in the operating speed of a vessel adds greatly to the costs of operation, and is very seriously considered by the shipping man. In aviation, essentially a speed industry, one would expect that factor to receive even more detailed consideration.

Two operators have told me that they have found that higher speeds are more economical—they can get in more trips in a given time, and, at a given cost per hour, they cover more distance. On the same reasoning, freight trains should travel at 60 m.p.h. and liners at 40 knots. This is a fair example of how only one aspect of the situation is considered in deciding highly important matters.

The passenger, like a broody hen, can do nothing but sit.

So far, the operator seems to be content to leave the design of transport planes to the guesses of various constructors, and then to back one of the guesses. At last operators are beginning to demand planes of lower operational costs, but are doing little about getting them. They encourage or permit the constructor to lay down the design on a basis of purely secondary considerations. For economy, the operator requires that all factors of speeds, seating accommodation, and loads should first be examined very carefully, which may well be a very complicated mathematical job. This examination should indicate the type of plane, and its construction, which best fulfills requirements.

Instead, the procedure is somewhat as follows.

It is decided to employ, let us say, a cantilever monoplane, because that is the popular type, or because of its association with high speed. It is then decided that it shall have metal-covered wings, because of someone's theories as to maintenance. This predetermines duralumin construction and rules out steel. Then someone wants a high-wing machine, because the passengers can see better, whereas someone else wants a low-wing so that he can have a retractable landing gear. On these purely secondary considerations the general design of the plane is laid down, and the primary requirements are forced to follow on behind. In other words, the flying point of view is governing transportation factors. This is a complicated subject, but is worth more consideration than it seems to get. Americans, probably more than any other people in the world, are remarkable for the meticulously detailed advance planning of industrial projects. Yet in aviation, where errors can be so expensive, guesses are so often allowed to supplant calculations.

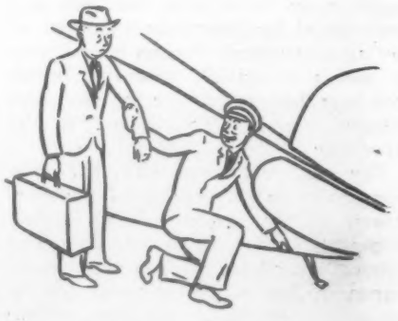
In actual operations the situation is equally interesting. Remembering the great increase of costs with increasing speed, a comparison with another transportation problem is interesting. An express train may average 50 m.p.h. over the rails, but, owing to various stops, the whole journey may be completed at an average of 45 m.p.h. The operator is paying for 50 m.p.h., and the passenger receives 45 m.p.h. The figures compare closely enough so that the operator can reasonably pass on the costs to the passenger. On the transcontinental air schedule, the passenger is taken from New York to Los Angeles in planes cruising at 120 m.p.h. in 36 hr., an average of about 75 m.p.h. How can anyone expect passengers, under such circumstances, to pay a rate profitable to the operator? The operator is paying for the speed and not using it. These are interesting figures. They show that delay in air transportation is very costly; that passengers must be able to remain longer in the plane so that comfort is doubly essential; that the overnight stop en route is impossibly inefficient from a cost point of view; that the air-rail system (pending the perfection of night flying) is the more efficient; and that the usual delays in air-rail connections are very expensive.

The fundamental conclusion from such figures is that these things should be much more closely calculated, and that opening of operations should occur only after such difficulties are overcome. Again, it is flying versus transportation. The operator is giving good flying and therefore thinks he is giving good transportation, but he isn't.

Unreliability and danger

It is reasonable to consider unreliability and danger together because, in aviation more than in anything else, they arise from the same causes, and the cures for one are usually the cures for the other. One often hears the opinion that the public will not fly until it is convinced that flying is safe. Equally the public will have little reason to fly until flying is more reliable,—until one can make an advance booking by air with something like the same assurance of arriving on schedule as by train. The two principal reasons for failure to do this are mechanical troubles and weather. As to the former we know roughly where we stand, and we are making steady progress towards the practical elimination of mechanical unreliability, but with regard to weather we are roughly where we were in 1914 (or for that matter 1814), except that we may have retrogressed a little. Formerly, with small light planes, we could hedge-hop the terrified passenger to his destination in thick weather. Now the Department of Commerce forbids the modern plane to fly passengers at less than 500 ft., a worthy decision which has not received a worthy interpretation. It means that the operator must not acquire reliability at the cost of danger. Still further it means that, if he wants reliability, the operator must fly above 500 ft. when the ceiling is below 500 ft. In other words, as has been said many times, *air passenger carrying, as an industry, will not start until the blind flying problem is solved.* It will be solved only by proper experimental work on the part of the operator, and it can so be solved. Most operators, however, are doing little or nothing about it, especially over those routes where the question is most serious, and, worse still, nobody is making them do anything about it. I have been accused of being unfair in this connection on the grounds that several operators really are fitting their planes with the latest blind flying devices and attempting to bring them to perfection. This may be so, but, with a long experience of all sorts of experimental work, I have found that the least conclusive and most expensive way of doing this sort of test is to combine it with operations. Such experiments should be a separate affair, and applied to operations only when they are concluded. Otherwise, the case is somewhat similar to that of trying to combine experiments and production in a factory.

It has been said that this experimental work would be very expensive. In any case, it is far more expensive to continue to carry passengers at a steady loss when that loss is largely due to the



The pseudo-technical bunk with which the passenger is filled . . . matters purely for the concern of the operator and which have nothing to do with the passenger.

fact that unreliability, and especially the difficulties and dangers of night flying, result mainly from inability to operate blind.

Fear

There is ample evidence that the general fear of flying, so great a handicap to aviation, is not a definite fear of being killed or maimed, but rather a vague impalpable disinclination towards the new and unknown. In some cases it will be cured by increasing public habituation to flying, but in many cases such fears will always remain, just as many people are still afraid of the sea and motor cars. Fear is relative, and we take risks today that our forefathers would have shuddered at, simply because we thereby get more service. If people who are afraid to fly can get very rapid travel for the money they spend, they will travel by air—in fact, they will have to. The greatest physical coward I ever knew once induced me to fly him from Paris to London in weather which kept the regular planes on the ground, as it was his only means of completing an important deal with a man sailing for America that day.

In a modern transport plane, designed for passenger *flying*, the timid passenger has little opportunity to suppress his fears. Cramped and confined to one spot, he is designedly compelled to keep his mind on the *flying*, which may be worse than uninteresting to him, simply because the plane is designed primarily to give him *flying*.

Fear is a perfectly normal, healthy human attribute. For air passengers the cure for it is not to lecture an unbelieving public on the stupidity of their fears, but to give them a service for which they will take certain risks as they do in all other forms of transport. The rest they will work out for themselves.

Comfort and air-sickness

Increased comfort is necessary to enable passengers to remain longer in the plane, and thus increase the final average speed. Time is not saved if the passenger is so exhausted that he must have a prolonged rest after ths journey. Comfort is mainly a question of room and absence of noise. In the average "luxury airliner" of today the passenger, like a broody hen, can do nothing but sit. He absolutely must have, not more space, but much more space. He should have some sort of reason, inducement, and opportunity to move about. To provide a very roomy cabin is a problem of weight rather than one of head resistance. At the moment it seems to be dealt with mainly by the vague hope that some day we shall have thick wings wherein everyone can walk about. The future of the "flying wing" seems to be so generally assumed that I might here point out that there are very excellent arguments that the planes of the future will not be thick "flying wings," but will be rather more efficient thin wings braced to very roomy, highly streamlined fuselages. At any rate, for the immediate future, I believe that far more room can be given passengers without any great sacrifice in efficiency, and without the immense costs associated with big departures from present design.

Far too much attention is paid to the question of the passengers' view out of the plane. For flying it is of primary importance, for transportation it is not, yet it has an unreasonably great effect on modern transport design. It is of importance, rather, to go to the other extreme, and so provide for the comfort and occupation of the passengers to remove the purely flying aspect of the trip. I recently brought some government officials some 1,400 mi. in one day, and their comment was that the trip was so comfortable that they forgot they were flying.

We take risks today that our forefathers would have shuddered at.

Air-sickness is another feature which can be very largely dealt with in design. Air-sickness is far more a question of nervousness than of the motions of the plane. Nevertheless, these motions always have something to do with the subject, and in this respect light wing loading often receives too much blame. Heavy wing loading is undoubtedly a help, but it is definitely limited for other reasons beside landing speeds. Passengers should obviously be grouped as closely as possible around the center of gravity.

Bad ventilation is a very serious cause of discomfort and air-sickness. Good ventilation is so easy to achieve that it is surprising how badly some planes stand in this respect, especially in cold weather.

Noise, to my mind, is one of those things which receive excessive theoretical and insufficient practical attention. Much research has been done to arrive at almost complete silence, and one day something may come of it, but very satisfactory results could be obtained now by greater attention to the immediate cooling of the exhaust gases. In this respect the in-line engine has the advantage over the radial, and the liquid-cooled over the air-cooled. The geared engine is practically essential.

All these points, so often regarded as incidental details and so often dealt with as afterthoughts, are really highly important matters in passenger carrying. If considered in the original design as primary instead of secondary matters, they would have a very considerable influence on the type of plane produced. The result would be more talk about loads and less about speeds.

Attracting passengers

Probably nothing illustrates the fact that there is only flying to sell as well as the advertising so commonly used, particularly the pseudo-technical "bunk" with which prospective passengers are filled. The ordinary man, who will use aviation only if it will get him somewhere so fast as to be worth the extra cost, is given mental fodder which may well give him aeronautical indigestion. The So-and-so Airline informs him, directly or indirectly, that he will travel on a famous plane; that it is tri-engined; that the engines are the famous Whatnots with which Captain Whoosit flew nonstop from Patagonia to Zanzibar; and that the pilots are personally selected by Captain Whoosit. These are matters purely for the concern of the operator and have nothing to do with the passenger. The passenger is left, however, with the impression that probably they are really important to him, and, knowing nothing about them, he is left merely in mental confusion. Having had the tri-engined idea pushed down his throat, he has a vague idea there is something missing in a single or bi-engined plane. He notices that on one of the most creditable airlines in the country, great efficiency is maintained by a type of engine that never did anything famous, so he thinks there must be a catch somewhere. These matters may interest the sporting or mechanically-minded, but the attitude of the ordinary public is, "We are not amused."

When the train takes me from New York to Chicago, I only know that I shall get there in a certain time at a certain cost with certain comfort and conveniences. I don't care who made the locomotive, who picked the fellow who drives it, what the coaches are built of, what signal system is used. Probably if I knew a little about those matters I should be less happy when I knew the train was travelling fast, but the railroad company does not confuse me with these things, because it is not trying to sell me a train ride.

Baggage

Baggage is another of those things which are regarded as suitable for afterthoughts, but which should be a serious factor in design, and, incidentally, in operations. It is rather

ridiculous to offer to take a man 3,000 mi. and allow him only 30 lb. of baggage. On the other hand it is obviously impossible to carry great baggage loads free. At any rate, it ought be possible for a passenger to take a reasonable load of baggage if he wants to pay for it. The load allowance or baggage accommodation of most passenger planes rarely provides for much more than the 30 lb. per passenger. Many European passenger planes can accommodate cabin trunks, and many passengers pay for that service. Certainly any plane for twelve passengers or more ought to have such accommodation.

An increase of the conventional 30 to 50 lb. ought to be considered. I have frequently heard expressed, and have often experienced, great irritation at a considerable surcharge for what seemed scant enough baggage. It is a difficult question, but it would be greatly helped by a lot of detailed examination. In airplanes offering serious transportation, however, the question of how much and what size baggage a passenger can take, how much he will have to pay for it, and where it shall be stowed must obviously be included in the calculations of loads, speeds and horsepowers, and therefore in the original design.

Conclusions

It must not be assumed that the public is not yet ready for air transportation. The reverse is the case; air transportation is not yet ready for the public. That is the whole business in a nutshell.

Air passenger operations are not merely failing to make money, they are losing heavily in most cases. In some cases the mail subsidy has enabled profits to be made, in others the mail subsidy has had to be sought to prevent companies from closing down with heavy losses. There are definite indications that the huge sums now being spent by the government on the air mail must be reduced, which is as it should be. There are many reasons why governments should and do support commercial transportation of various sorts by mail contracts—there is no reason why governments should repair losses which, there is reason to think, the operators could themselves avert through greater commercial efficiency. In other words, air transport companies *must* make more, or lose less money on their passenger-carrying whether they have mail contracts or not.

The reasons for the great losses so far are not far to seek. Many passenger lines have been initiated with little, if any, regard to the possible factors involved. Huge expenditures were made in the purchase of planes regardless of their profit-making possibilities, speeds, or loads, merely because they were probably the best available. Some of these planes were put into mass production and sold below cost before there was any evidence that an operating profit might be made on them. The result was not only to clutter up the airlines with a superfluity of unprofitable planes, but also to put out of competition anybody who might stand a chance of showing better economy.

Large numbers of expensive planes were put into expensive operation before there was any reasonable indication that the public would buy the services offered, and when there was plenty of evidence that it might not.

The original cause of the trouble seems to have been the idea that *something* had to be started, and therefore one had to use whatever was available. This might have been so in Europe, for in almost every case there was military or political reason for having something running, for testing and maintaining the new form of communication with distant dependencies and military outposts. In commercial America there was no reason whatever for starting passenger lines until experiment, research, and experienced calculation, such as Americans put into other expensive undertakings, had given them something to go on.

Airplanes have to do a certain amount of work. They do this with the power they use. With the power available they must compromise between loads and speeds. The loads bring in the money and the speeds cost the money. One can have more load and less speed, or less load and more speed. There is a tendency toward too much speed and too little load, and, in my opinion, that is one of the main troubles both with existing airplanes and with the trend of design. Instead of a closely balanced comparison of all figures concerning load and speed, there is a growing tendency to chase rainbows of super-efficiency in such projects as fat-winged cantilever monoplanes with everything inside the wings. Neither theory nor practice shows any advantage in this sort of thing, yet it goes on at great cost. Let us try this sort of thing only when we have perfected the things we know, and have made some money out of them. Today everything points to the fact that we must have more of the loads which pay money and less of the speeds which cost the money. In my opinion this leads directly to greater wing area and less horsepower, which in turn leads to the despised biplane which, if the design is carefully considered, can give all and more than can be expected from more radical and more expensive developments. If dollars and cents rather than "advanced" design were made the basis of transport developments, there would be considerable change in the outlook on transport plane design.

Above all, for real commercial air transportation, extremely high airplane speeds mean little today. Real speed is not the flying speed but the overall average of the journey. This is yet to be greatly increased by improved operations and reliability, which will give us faster transportation for slower and cheaper flying.

Program of the A.S.M.E. (Aeronautics Division) meeting at Baltimore

Tuesday, May 12, Morning

Operation Session: "An Analysis of Various Airplane Types for Transport Uses", Capt. F. T. Courtney; "Maintenance of Equipment in Air Transport Operation", Lester D. Seymour; "Aircraft Servicing Problems", Charles Froesch.

Design Session: "Design and Possibilities of the Light Airplane", J. Henry Reisner; "Airplane Design and Relation to Tactical Requirements", Temple N. Joyce; "Weight Control in Airplane Design", Wm. P. McKinne.

Engine Session: "Analysis of Aircraft Engine Design", Harold Caminez; "Development of Engines for Light Airplanes", Henry Lowe Brownback; "Two Cycle Aircraft Engine", J. H. Geisse.

Tuesday, May 12, Afternoon

Airport and Management Session: "Airports for Small Cities", E. L. Wheless; "Engineering Essentials and Airport Enclosurers", Capt. Frederick Schauss; "Architectural Principles Applied to Airport Planning", Prof. H. V. Walsh; "Actual Cost of Operating a Business Airplane", Jerome Lederer.

Construction and Materials Session: "Special Methods of Testing Aircraft Materials", D. M. Warner; "Plywood in Aircraft", Geo. L. Fisher; "Types of Design and Their Effect on the Structural Design of Airplanes", F. S. Hubbard.

Engine Session: "Altitude Laboratory Tests of Aircraft Engines", Dr. H. K. Cummings and E. A. Garlock; "Aircraft Engine Testing and Testing Laboratories", R. N. Dubois; "Junkers Aero Diesel Engine Type FO-4", Junkers Research Institute, Germany, presented by Fred Melchior.

Tuesday, May 12, Evening

"The Aviation Lessons of the Antarctic Expedition", Lieut. Bernt Balchen.

Wednesday, May 13, Afternoon

Metal Session: "Construction of the Metal Airplane", Geo. H. Prudden; "Some Effects of Corrosion-Fatigue on Streamline Wire of Aircraft", Lieut. H. E. Haven; "The Cause and Prevention of Heat Cracks in Aircraft Welding", H. S. George.

Propeller Session: "Racing Propellers for Light Airplanes", Fred E. Weick; "Magnesium and Hollow Steel Propellers", G. T. Lampton; "The Value of Controllable Pitch Propellers", W. B. Heins; "Controllable Pitch Propellers", Frank W. Caldwell.

A report of the Fifth Annual Technical Meeting at Baltimore

The A.S.M.E. discusses aeronautics

SPONSORED by local engineering groups, the Aeronautics Division of the American Society of Mechanical Engineers held its Fifth National Technical Meeting in Baltimore on the three days beginning May 12. A total registration of 450 persons was recorded, including over 270 from outside the Baltimore district. Sessions were held at the Hotel Lord Baltimore, the Engineers Club, and the Curtiss-Wright Airport. The discussion covered practically all phases of aircraft design, construction and operation. The complete program, including a list of all paper's read, appears on this and the opposite page. In the following a few of the outstanding papers picked at random from the various sessions will be discussed in some detail.

Operators compare notes

With the immediate prospect of material reduction in direct financial assistance from the government hanging over their heads, airline executives are combing over every possible method of effecting economies in the selection and maintenance of their equipment. Mr. F. T. Courtney, of New York City, in analyzing the situation in a "Comparison of Airplane Types from the Transport Standpoint" concluded that high speed is too often considered the primary requirement, and given preference over load-carrying capacity and passenger comfort. Once these latter factors are given their proper consideration, he believes that economical considerations will divert the trend of design, for purely transport types, at least, from the present day insistance upon aerodynamically clean, cantilever monoplane designs, with their high wing loadings, and attendant high landing speeds, toward the older biplane type with relatively thin wing sections. He raised the issue as to whether or not designers today were using such innovations as stressed skin coverings, and even air-cooled engines, merely for the sake of being modern without really taking account of the various economic factors involved. His studies had led him to the conclusion that the biplane, with sufficiently light wing loading to permit reasonable landing speeds, and having multiple, water-cooled power plants more nearly filled current transport requirements than any other known type. This statement, presented before a mixed company of airplane designers naturally led to some difference of opinion, which was freely expressed.

Economy in operation, as contrasted with Mr. Courtney's discussion of economy in selection, was the theme of "Aircraft Servicing Problems" by Charles Froesch, general service manager, Fokker Aircraft Corporation of America. Servicing airplanes falls into two categories: (1) manufacturer's service, including technical field service, supply of parts, and operation of servicing stations; and (2) operator's service, covering maintenance methods, airplane and engine overhaul, and the selection and maintenance of shop equipment. Under present conditions the first requisite from the manufacturer's point of view is the establishment of a good factory servicing station, with strategically located regional branches. A sound basic design for the central station should be worked out, taking all factors of transportation and handling, storage, parts distribution, and repair facilities into account, and the regional stations based on the same design, making allowances for the requirements of purely local conditions. The administration of the factory servicing system should be under the control of the sales department, as sales and service must function together. The selection of the field personnel is

Training and Navigation Session: "Vocational Training in Aviation", Frank Cushman; "Modern Flight Training", Major W. D. Tipton; "The Aviation Course at the U. S. Naval Academy", Lt. Comdr. D. C. Ramsey; "The Ice Hazard on Airplanes", Dr. William C. Geer.

Thursday, May 14, Morning

Aerodynamic Session: "Control at Low Speed", Lieut. Carl Harper; "A Study of Stabilizer Beam Loadings in a Dive and During a Sudden Pull-up", W. H. Miller; "Tail Spinning of Aircraft", G. G. Budwig; "Decrease of Disturbed Motion in the Flight of an Airplane", M. Louis Breguet.

Engine Session: "Wing Radiator Development", G. A. Luburg; "Engine Ring Cowls", W. H. Evers; "Engine Ring Cowls", A. M. Boyd; "Observations on the Development of the English High Speed Oil Engines from Submarine to Airship R-101", Alan E. L. Chorlton.

Instrument Session: "Instrument Flying and Its Teaching", Major W. C. Ocker and Lieut. Carl J. Crane; "Performance of Aneroid Altimeters for Landing and for Level Flying", Dr. W. G. Brombacher; "The Sonic Altimeter", C. W. Rice; "The Directional Gyro", E. A. Sperry, Jr.

Thursday, May 14, Afternoon

Communication Session: "Radio Methods for "Flying and Landing Airplanes in Fog", H. Diamond and F. W. Dunmore; "Transmission of Visible, Infra Red, and Ultra Violet Radiations through Fog with Reference to Developing Aids and Fog Flying", S. Herbert Anderson; "Effect of Lightning on Airplanes", A. O. Austin; "Discussion on Airways Communication", Eugene Sibley, Geo. G. Breed, H. A. Elliott and H. N. Willets.

Airship Session: "The Mooring and Ground Handling of a Rigid Airship", Comdr. C. E. Rosendahl; "Water Recovery Apparatus for Airships", Charles P. Burgess; "Stresses in Rigid Airships; The Effect of Indeterminates on Their True Value", W. Watters Pagon; "Technical Problems in Airship Design", W. A. Klikoff.

General Design Session: "The S-Rotor", S. Savonius; "Discussion on Propeller Type Wind Mill", E. N. Fales; "The Autogiro Rotor", Heraclio Alfaro; "Supercharging the Engine and Increasing the Speed with Altitude", Robert J. Nebesar.

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extremely important, as it not only contacts the customers directly, and as such has tremendous influence on good will, but it is also in a position to collect data and information on operating conditions which can be of great assistance to the engineering and production departments. The writing up and distribution of servicing manuals, and the detailed investigation of all complaints, are primary functions of a service department.

The determination of the life of the equipment, however, rests with the operator. It is quite possible today, by making periodic overhauls, and by continually replacing worn parts, to make obsolescence, rather than wear, the reason for making equipment changes. This places the burden upon inspection —as parts which are subject to wear must be replaced before they become hazardous—and all repair work must be carefully supervised to see that it complies with the requirements of the Department of Commerce for strength and weight. On the latter point it is of interest to note that the average transport airplane of about 2,500-lb. payload picks up between 500 and 600 lb. of additional weight during the first year of operation over and above the total allowed for in the original A.T.C. Welding must be carefully watched, riveted joints properly made, and the contours and alignment of tail surfaces continually checked. Brake linings and engine controls require special attention. For the latter it has been found that if before splicing they are boiled in linseed oil for half an hour, dried, and covered with a coat of Prussian blue, no maintenance other than greasing should be required in 700 to 1,000 hours of service. Instruments, especially tachometers, require frequent servicing, and replacement of worn parts rather than attempted repair should be the rule. Little need be said about the need for regular engine overhaul. Present practice dictates a complete overhaul between 250 and 500 hours, depending upon the service and the engine r.p.m. at cruising speed. Experience indicates that engine overhauls cost from $1 to $1.75 per flying hour, varying with type and airplane cruising speed.

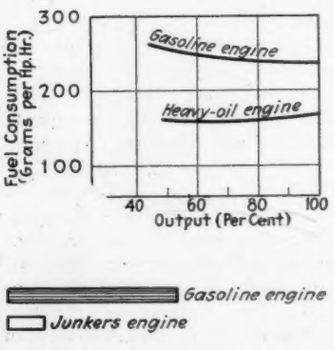
With the designers

As would be expected, attention this year was focused rather sharply upon the light plane, and its possibilities in developing the heretofore stagnant private market. Mr. J. Henry Reisner, of the Kreider-Reisner Company in "The Design and Possibilities of the Light Plane" put the light plane in two categories—(1) the low powered machines with engines of 50 hp. or less, with seats for one or two persons, and (2) the medium powered class of two or three seaters with power plants of 50 to 100 hp. Both classes may inherit their characteristics from either of two sources—they are either "scaled-up" from gliders or soaring machines, or "scaled-down" from higher powered airplanes. The ultimate designs will probably be a compromise, although there is definite psychological advantage from a sale point of view in having them resemble their higher powered relatives.

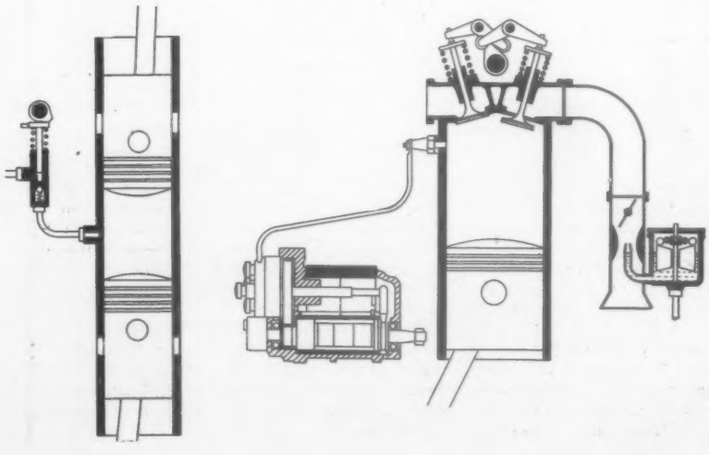
At the moment, the high wing, strut-braced monoplane is in favor as it permits simple design, moderate cost, low weight, and ease of repair. Problems of pilot vision have yet to be completely solved, however, although a tendency toward pusher types has improved conditions in some cases. Where this arrangement is used, it has usually been found necessary to increase the ratio of tail to wing areas to maintain control at low speeds with power off. With the advent of lighter power plants, the problem of surface and power loadings is becoming more rational. Flat gliding angles and slow landing speeds are important, but the accompanying floating tendencies in landing are not always desirable, and will have to be controlled by some form of air brake. Folding wings are almost essential from the standpoint of the private owner, and the simplification of landing gears by the elimination of shock absorbers other than the tire is a step in the right direction.

Taken as a whole, light plane design offers the engineer his greatest opportunity to exercise his ingenuity. Price, performance, adaptability, accessibility, comfort, and convenience are paramount issues, and, due to the narrow margin in which he must work, the selection of materials and their arrangement must be carefully considered to produce a balanced product. With a satisfactory solution to such problems, the light plane offers tremendous possibilities in improving the private market, as it permits greatly reduced training costs and, by increasing the number of persons who can afford to fly, will eventually create a demand for airplanes of higher performance.

Mr. Walter C. Davis, of the Davis Aircraft Corporation, in commenting on Mr. Reisner's paper disagreed as to the extent of sales of really light planes to private owner, but admitted that they offer a very excellent means of obtaining instructions at reasonable cost. He believes with Mr. Reisner that the two- and three-place airplanes of 100 to 150 hp. will become the basis of the private market. Prof. Otto C. Koppen of the Massachusetts Institute of Technology was also of the opinion that the light airplane was useful for solo instruction only, and had limited possibilities as a private vehicle. Landing speeds correspond more nearly to those of the early airplanes, whose pilots taught themselves to fly, than in anything else now on the aeronautical market. He disagreed with Mr. Reisner upon the desirability of simplifying landing gears by fitting low pressure tires without other shock absorbing equipment, as he contended that tires alone do not have sufficient capacity to handle the shock of the steep landings for which the light airplane should be designed. The remaining discussion stressed the need for complete lateral control at low speed, and also brought out the necessity of lowered first cost before the



Comparison of Junkers aircraft diesel engine with conventional light fuel engine of equal horsepower. F. Melchior—"The Junkers Aero Diesel Engine"

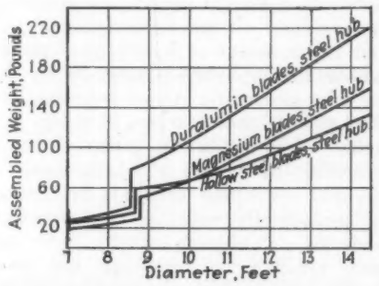


market will really develop to any appreciable degree.

Mr. George H. Prudden, special consultant for the Keystone Aircraft Corporation, and formerly associated with William B. Stout in the development of the Ford all-metal transport, in his paper, "Construction of the Metal Airplane," pointed out that rediscovery of the soft die process eliminates the necessity of carrying a heavy die inventory, and may make the all-metal airplane cheaper to construct than any other form. Although transport planes of conventional, composite construction cost between $3,000 and $4,000 a seat, it is now quite possible to produce machines of higher performance, better appearance, and greater durability for a cost of $2,000 a seat. Aside from the greater economy of temporary soft metal dies, he stressed the necessity of more complete understanding on the part of the engineer of the problems which are encountered by the man in the shop.

Engine builders discuss accessories

The experience of the Curtiss Aeroplane & Motor Company with wing radiators, particularly for racing machines, was covered by G. A. Luburg, assistant chief engineer. An increase



Relative weights of two bladed metal propellers. G. T. Lampton—"Magnesium and Hollow Steel Propellers"

of from 4 to 7 per cent in high speed is to be expected at 200 m.p.h. by the use of wing radiators as compared with the more usual honeycomb type. The leading edge section dissipates, approximately 80 per cent of the total heat. The weight of the radiator installed and filled with water runs from 0.33 to 0.53 lb. per hp., and the number of sq.ft. of cooling surface per hp. is approximately 0.51 at 200 m.p.h. and 0.44 at 250 m.p.h. for the tubular type, and 0.36 at 300 m.p.h. for the smooth skin type. The general use of wing radiators is open to question as they are expensive to build and are subject to damage. The use of prestone as a coolant reduces the required area of the honeycomb type, and offers a much more practical solution for airplanes other than those designed for extremely high speeds.

One of the most interesting aerodynamic developments of the past two years is the reduction of drag of air-cooled radial engines by the application of cowling. Two papers on this subject were presented, one by Mr. Paul M. Boyd of the Curtiss Aeroplane & Motor Company, and the other by Mr. W. H. Evers of the Fokker Aircraft Corporation. History of the development of engine cowling was covered by Mr. Boyd, and Mr. Evers made a detailed comparison of the N.A.C.A. and Townend types, for both aerodynamic efficiency and operating economy. He concluded that where maximum speed was paramount the N.A.C.A. cowl was superior, but for practical airline operations where questions of cost, weight and maintenance are of more importance than top speed, the narrower Townend type is to be preferred. A series of comparative costs (Table IA) given by Mr. Evers is of sufficient interest to reproduce here. He gives data on a typical transport equipped with three Wasp engines. The saving is shown in Table IB.

Table IA

Average cruising speed with conventional cowl	119.5 m.p.h.
Average cruising speed with ring cowling	126.0 m.p.h.
Average gain with ring cowling	6.5 m.p.h.
Payload	2,700 lb.
*Operating cost per plane-hour incl. 35 per cent overhead	$87.00
*Cost per plane mile (conventional cowling)	$0.73
*Cost per pound of payload-hour	$0.0537
*Cost per pound of payload-mile	$0.00027
Initial cost of three ring cowlings	$375.00
Cowling life in hours flying time	1,000
Depreciation per hours flying time	$0.375
Weight of three ring cowlings	60.0 lb.

*Based on 119.5 m.p.h. cruising speed and 60 per cent average payload = 1620 lb.

Table IB

Saving due to increase in speed (5.5 in. @ $0.73)	$4.75
Depreciation per flying hour	0.38
Additional labor for servicing engine	0.15
Total saving per hour flying time	4.22

Propellers

The fact that many of the fastest light airplanes have been equipped with propellers differing widely from those developed by the Army and Navy has led to some question as to what constitutes a good form for this purpose. F. E. Weick of the N.A.C.A. attacked the problem by carrying through the design of a propeller for a specific case, and having arrived at what appeared to be the optimum propeller for his airplane, studied the effect on the efficiency and on the maximum speed of changing its shape systematically in every possible way. He concluded that any propeller designed within reasonable limits of good practice has relatively small effect on the high speed of an ordinary light airplane. The conditions of body form, engine power, r.p.m., and airplane speed are all of considerably greater importance than the propeller design, and the designer, with these factors beyond his immediate control, has but small chance of increasing the maximum speed by even 1 m.p.h. over that which can be obtained with the best standard propeller which can be selected from available charts. F. W. Caldwell, vice-president of the Hamilton Standard Propeller Company, in commenting on Mr. Weick's paper suggested that a copy of it be mailed to everyone who claims to have increased airplane speed materially merely by changing propellers.

Work done recently by the Hamilton Standard Propeller Corporation in developing new materials, was discussed in a paper on magnesium and hollow steel propellers, by G. E. Lampton. A sample hollow steel blade made by a new process was exhibited. Hollow steel propellers show considerable promise in that they are less susceptible to corrosion, their harder surfaces resist abrasion better than does aluminum, and weight may be considerably reduced. It was reported, for example, that a three-bladed 13-ft. steel propeller will weigh 140 lb. against 250 lb. for the corresponding duralumin assembly. On the other hand, the steel propeller has certain disadvantages: (1) the tips cannot be cut off to reduce diameter; (2) blades bent in minor accidents cannot be straightened, and (3) the blades do not fit standard hubs.

Problems in aerodynamics

Control at low speed is important for all types of aircraft, but it becomes a major problem in connection with the landing of naval planes on the decks of carriers. Lieut. Carl B. Harper, who has had a great deal of experience in flight testing machines fitted with slots and flaps, described various combinations of such devices and their effects on control. He analyzed the probable causes of several of the recent crashes which have received wide publicity, showing how they probably occurred due to sudden use of large horizontal tail surfaces designed primarily to insure control at low speed. In commenting on Lieutenant Harper's paper, Mr. F. E. Weick described the recent work done by the N.A.C.A. in the prevention of stalling by limiting the upward travel of the elevator on a standard airplane. Mechanical stops are provided so that with the stabilizer full down and the elevator full up, the airplane assumes an attitude slightly under its normal stalled position. This adjustment can be made so that all ordinary maneuvers, including a normal three-point landing, may readily be made. No limitation is placed on the down travel of the ele-

vators, and the only other necessary modification was improvement of the landing gear to permit the airplane to be landed at its maximum angle of glide without damage. The detailed results of the test are to be published shortly by the N.A.C.A. The Navy has also made some experiments with upward limitation of elevator control, but they have not proven entirely satisfactory because it is often desirable to make a full stalled landing in exceptionally rough water. T. P. Wright asked Lieutenant Harper if he had ever had any experience in flying an airplane in which the slots were open on one side and closed on the other, and the latter described a flight test on a Curtiss Sea Hawk in which he was able to hold the airplane at such a speed that the conditions described by Mr. Wright took place. No difficulty was experienced in keeping the airplane on its course, and he did not believe that it was necessary to interconnect the slot gears mechanically. Mr. Weick asked about the possibility of spoilers in connection with slot or flap gear, and Lieutenant Harper stated that he believed that spoilers were due to come into more general use as their advantages were more widely known. They offer decided improvements in lateral control, particularly in recovery from spinning. He pointed out, however, that it is absolutely necessary to equip spoilers with a positive control as some difficulty has been experienced with improperly fitted spring operated spoiler gear.

Prof. Alexander Klemin of New York University read a paper by Louis Breguet, the famous French constructor, analyzing the motion of an airplane in flight and the effect on passengers. He concluded that the main sources of discomfort in the air are not from rolling or yawing motions, but are from vertical oscillations of the center of gravity, and from pitching motions. He outlined several theoretical possibilities for overcoming this defect, without indicating in detail the practical methods by which they might be accomplished. Mr. Wright pointed out that the question of air sickness was of great importance among the transport operators and the question was raised whether high speed aggravated rather than reduced the effects. It was the general opinion that if the direct causes of discomfort were as described by M. Breguet, they would be aggravated rather than reduced as the speeds increased, for the effect of slight changes in incidence on the lift would be magnified as the speeds went up.

Mr. W. H. Miller of the B-J Aircraft Corporation presented a study of stabilizer beam loading during a sudden pull up. He commented on the inadequacy of the data on which horizontal tail surfaces had been designed, and indicated that by the usual methods it is very easy to introduce errors of the order of 10 per cent. His analysis had indicated that full mathematical treatment is highly necessary in the design of tail surfaces and that the usual procedure of distributing an average loading over the tail may easily prove inadequate in certain cases where extremely high loads concentrate on the stabilizer beams. He indicated that his theoretical study of pull-out conditions agreed very closely with the results of flight tests made by the N.A.C.A. The full details of Mr. Miller's paper will be available for publication in the near future.

Table IIA

This table shows the operating costs per mile and how they decline as the use increases (due to the greater spread of the yearly fixed costs over mileage).

Hours used per year	Total yearly operating cost	Cost per mile at 105 m.p.h.
200	$11,030.20	$.52
300	12,122.20	.38
400	13,214.20	.31
500	14,306.20	.27

Continuing this to 750 hr., the cost per mile would be 22 cents, and at 1,000 hr., it would be 19 cents, but the replacements and depreciation would probably be higher, thus increasing the cost.

Table IIB

Yearly fixed costs	Percentage of total cost			
	200 hr.	300 hr.	400 hr.	500 hr.
Depreciation of plane	12.3	11.2	10.1	9.5
Depreciation, equipment	1.4	1.3	1.2	1.1
Pilot's pay	36.0	33.0	30.1	28.0
Pilot's insurance	5.0	4.6	4.2	3.9
Insurance	15.8	14.3	13.1	12.2
Plane overhaul (less engine)	4.1	3.7	3.4	3.2
Storage	4.2	3.8	3.5	2.9
Miscellaneous	1.1	1.1	1.0	.9
Total fixed costs	80.2	73.0	67.6	61.7
Hourly operating cost				
Engine depreciation	4.7	5.7	7.8	9.1
Engine overhaul and maintenance	5.2	7.1	8.7	10.1
Gasoline	6.4	8.7	10.8	12.4
Oil	1.3	1.7	2.1	2.5
Transportation	2.2	2.8	3.6	4.2
Total operating cost	19.8	27.0	32.4	38.3

The business airplane

Aside from possible publicity benefits (which are rapidly diminishing) the only argument which will be given a hearing today by American business organizations in favor of their making use of privately owned air transport is that of definite dollars and cents savings, and it is obviously impossible to demonstrate savings without a full knowledge of what it actually costs to own and operate flying equipment. Unfortunately, there have been few reliable data compiled on this subject. An analysis of costs is particularly timely. About a year ago, the Aero Engineering & Advisory Service, Inc., of which Mr. Jerome Lederer is vice-president, purchased a three-place open cockpit biplane of conventional design, powered with a seven-cylinder, 225-hp. radial engine. Two months later a second machine of the same type was bought, and both planes have been used to inspect aviation insurance risks in all parts of the United States. Complete cost data were kept on the two airplanes, and accurate figures are available on all items of expense. The results of Mr. Lederer's analysis are in Table IIA and IIB. The former shows how total cost and cost per mile vary with the number of hours flown per year, and the latter shows the relative importance of the various factors which enter into the total cost for various hours of usage of the airplane. It will be noted that the largest item in Table IIB is the combined pilot's pay and insurance, but it may safely be assumed that as planes are developed which are more dependable and easier to fly, the relative importance of this item will be materially reduced.

Ice formation and spinning

One of the greatest hazards to flight under adverse weather conditions is the formation of ice on wings, struts and propellers. Mr. William C. Geer, research chemist, reported on work which had been done jointly by the National Air Transport Company and the B. F. Goodrich Rubber Company in attacking the problem. It has been demonstrated that the removal of ice from airplanes can be accomplished practically by the use of a pneumatic rubber overshoe applied to the leading edges of wings and struts. The rubber is given chemical treatment to reduce the adherence of ice, and ice which forms is broken up by periodically inflating the overshoe with air. Although results have not been positive in removing ice from small wires or from propeller blades, considerable research work is being done in this direction, and indications are that some practical solution will be reached in the near future.

Mr. Gilbert G. Budwig of the Department of Commerce outlined the history of the study of tail spinning and indicated that the investigations of the Department had determined that there were four factors which in most cases determined spinning characteristics: (1) the machine should be stable about all three axes; (2) the center of gravity should be well forward with respect to the center of pressure; (3) the wing loading should be kept below a certain maximum limit which is dependent upon the characteristics of the airfoil used; and (4) weights of airplane and cargo should be grouped as closely as possible about the center of gravity. In closing Mr. Budwig paid tribute to the splendid cooperation which manufacturers had given the Department in the last two years. There was, he said, much less tendency today for manufacturers to attempt to "put over" anything on the Department now than in the past.

Facsimile of listing mailed to the entire group of prospects on the company's records, and samples of photographs of a plane listed for resale and sent to particularly likely prospects to illustrate its condition.

Used airplanes

The methods of a California company which successfully deals in them should be of particular interest to salesmen

SUCCESSFUL merchandising of used planes has been accomplished by the Claiborne & Deeds Company, Grand Central Air Terminal, Glendale, Cal., through carefully compiling and intensively cultivating a list of approximately 1,800 prospective airplane buyers in the eleven western states.

This list has been developed over a considerable period of time by taking from the weekly bulletins of the Aeronautical Chamber of Commerce the names of all individuals or companies in the eleven western states who have been involved in the buying or selling of aeronautical equipment valued at $250 or more.

A monthly bulletin listing aeronautical equipment offered by the Claiborne & Deeds Company is sent to all the prospects. This bulletin is printed on a 5x8-in. card and a hole, perforated near the upper border and labeled "Hang Me Up," encourages prospects to hang the card in a prominent place. This feature greatly increases the life of the bulletin as the ordinary letter paper bulletin is more likely to go into the waste basket, or out of sight under a pile of correspondence. Return postage is guaranteed, and additional postage is guaranteed to cover cost of notifying sender if addressee has moved. Also, stamped and return-addressed cards are occasionally mailed to the entire list in order to determine who is not using or does not want to receive the bulletin. These precautions serve to keep the list active at all times.

Secretarial expense is minimized by staggering the mailings of the bulletins throughout the month, sending a certain portion of them each day over a considerable period of time. This not only helps to reduce the cost of mailing the bulletins, but it serves to bring replies in at a fairly even rate throughout the month, reducing the expense of handling inquiries and making it possible to give more and quicker attention to each individual request.

A carefully prepared personal letter is sent in reply to each inquiry, rather than attempting to satisfy bona fide inquiries with some mimeographed or printed form, or a type letter covering each particular plane. Where an inquiry is judged to be of a particularly likely sort, actual photographs are sent to the prospective purchaser, illustrating the airplane in which he is interested. These photographs are made by the company with its own camera and at comparatively slight cost. The favorable response which they have brought proves that this feature is well worth the expense.

In addition to conducting a constant solicitation by mail, as outlined above, the company has a large stock of used planes on display in a hangar on Grand Central Air Terminal, within approximately six miles of downtown Los Angeles and less than five miles from Hollywood. The planes are taken in on a consignment basis, the owner paying cost of hangar rent in most cases. A minimum price for the plane is fixed by the owner and the Claiborne & Deeds Company agrees to accept a predetermined percentage of the actual sale price as their commission.

Two salesmen are kept out in the territory all of the time, traveling the eleven western states to search out new prospects and to follow up those uncovered by the mail campaign. These men travel by train or private auto and carry with them a handbook in which is listed the complete set of information on each plane offered for sale. In addition to these information sheets the salesmen carry actual photographs of the planes, showing their present condition, and also carry a complete set of manufacturer's catalogs covering the types of planes listed.

No equipment is handled unless it is in licensable condition. When mechanical work must be done on the plane or engine, the unit is turned over to the local Curtiss-Wright repair station at the expense of the owner.

Table 1: American landplane specifications

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

CONTINUED ON PAGE 430

Manufacturer	Designation	A. T. C. No.	Price at Factory	Type	No. of Seats	Make of Engine	Total Rated Hp.	R.p.m. Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed, Gal. per Hr.	Diameter of Propeller-In.	Wing Loading (Lb. per Sq.Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Water if Used	Pay Load (Lb.)	Gross Weight (Lb.)	High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
PASSENGER PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																								
Aeromarine Klemm Corp.	AKL-25-A	121	2,250	OML	2	Salmson	40	2,000	15	330	2.7	86.5	6.8	33.1	815	239	1,325	74	60	1,750	40	400	8,500	Ms
Aeromarine Klemm Corp.	AKL-26-A	204	2,500	OML	2	Lb	70	1,950	29	480	4.75	86.5	6.8	22.7	1,025	206	1,590	93	78	1,650	42	600	12,000	Ms
Aeromarine Klemm Corp.	AKL-26-B	334	3,300	OML	2	Lb	85	2,125	29	465	5.3	86.5	8.2	18.7	1,016	215	1,590	97	85	1,800	42	700	14,000	Ms
Aeronautical Corp. of America	Aeronca Scout	351	.....	OML	1	Aeronca	26.0	2,500	8	240	2.0	64	4.9	26.9	426	50	700	75	60	2,200	28	550	16,500	Ms
Aeronautical Corp. of America	Aeronca PC-2	351	.....	OMS	1	Aeronca	26.0	2,500	8	240	2.0	64	5.5	29.9	482	50	756	72	58	2,200	32	400	12,500	Ms
Aeronautical Corp. of America	Aeronca C-3	396	.....	OML	2	Aeronca	36.0	2,400	8	240	2.5	72	6.2	25.0	461	20	875	80	75	2,150	32	450	12,000	Ms
Alexander Aircraft Co.	Eaglerock A-2	58	1,850	OBL	3	OX-5	90	1,400	47	460	7.2	.....	7.40	27.1	1,459	340	2,442	100	85	1,375	35	460	9,000	Ms
Alexander Aircraft Co.	Eaglerock A-14	139	5,247	OBL	3	Wr Ww	165	2,000	67	625	9.0	.....	7.83	17.2	1,685	340	2,582	116	104	1,700	37	720	12,820	Ms
Alexander Aircraft Co.	Eaglerock A-15	190	3,400	OBL	3	K	90	1,720	47	550	6.0	.....	7.45	24.46	1,539	340	2,456	100	85	1,600	35	480	9,400	Ms
Alexander Aircraft Co.	Eaglerock A-13	141	4,350	OBL	3	Cu Ch	170	1,800	67	655	9.0	.....	7.89	14.49	1,711	340	2,608	119	100	1,700	37	840	14,700	Ms
Alexander Aircraft Co.	Eaglerock A-1	57	2,000	OBL	3	Wr Ww	225	1,700	67	590	11.0	.....	7.55	12.46	1,705	340	2,491	130	110	1,650	36	1,080	17,900	Ms
American Airplane & Eng. Co.	Pilgrim KR34C	162	.....	OBL	3	Wr Ww	165	2,000	45	465	9.2	102	8.32	14.35	1,524	380	2,368	121	97	1,700	48	655	13,900	Ms
American Airplane & Eng. Co.	Pilgrim KR34D	367	.....	OBL	3	Co	165	1,900	45	435	9.8	102	8.34	14.36	1,515	389	2,371	122	97	1,650	48	700	15,200	Ms
American Airplane & Eng. Co.	Pilgrim KR21	215	.....	OBL	2	K	100	1,810	22	390	5.0	90	8.49	16.35	1,100	210	1,635	105	85	1,550	50	515	9,500	Ms
American Airplane & Eng. Co.	Pilgrim KR21B	363	.....	OBL	2	K	125	1,925	30	400	7.0	96	8.98	13.83	1,120	237	1,730	117	97	1,600	52	890	15,200	Ms
American Airplane & Eng. Co.	Pilgrim 135	415	.....	OBL	2	Rr	120	2,150	30	390	7.2	84	9.02	14.42	1,155	210	1,745	112	93	2,050	52	785	14,900	Ms
American Eagle Aircraft Co.	330	119	4,795	CML	3	K	100	1,850	32	400	8.5	.....	.....	.....	1,320	425	2,100	95	85	1,750	36	700	12,000	Ms
American Eagle Aircraft Co.	251	282	5,995	OBL	3	Wr Ww	165	1,850	60	550	9.0	.....	.....	.....	1,650	527	2,669	128	110	1,800	35	780	16,000	Ms
American Eagle Aircraft Co.	201	293	3,995	OBL	3	K	100	1,850	36	425	8.5	.....	.....	.....	1,168	366	1,950	115	100	1,750	30	700	14,000	Ms
American Eagle Aircraft Co.	Eaglet	380	1,475	OML	2	Sz	30	1,800	18	250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Arrow Aircraft & Motors Corp.	A-2-60-L	115	2,700	OBL	2	Lb	60	1,950	16	200	6.0	.....	7.35	19.5	900	170	1,346	100	85	1,800	30	900	14,000	Ms
Brunner-Winkle Aircraft Corp.	Bird A	101	.....	OBL	3	OX-5	90	1,400	45	600	7.0	.....	8.1	24.0	1,300	400	2,150	110	90	.....	.....	700	15,000	Ms
Brunner-Winkle Aircraft Corp.	Bird B	239	.....	OBL	3	K	90	1,825	35	525	6.0	.....	7.5	22.0	1,190	400	1,990	110	90	.....	.....	800	16,000	Ms
Buhl Aircraft Co.	CA-3-D	163	12,000	CQL	3	Wr Ww	300	2,000	90	700	16.0	.....	13.3	10.66	2,017	413	3,200	150	125	1,750	45	900	15,000	Ms
Buhl Aircraft Co.	"Bull Pup"	405	1,250	OML	1	Sz	45	1,750	10	260	2.6	.....	6.96	18.88	550	.....	850	98	78	1,600	.....	780	14,000	Ms
Curtiss-Wright Airplane Co.	Robin OX-5	68	.....	CML	3	OX-5	90	1,400	50	481	7.0	.....	10.1	25.1	1,504	390	2,270	105	84	1,180	44	400	10,200	Ms
Curtiss-Wright Airplane Co.	Robin C-1	143	.....	CML	3	Cu Ch	185	1,800	50	300	14.0	.....	11.7	14.05	1,638	454	2,600	120	102	1,530	47	640	12,700	Ms
Curtiss-Wright Airplane Co.	Robin J-1	220	.....	CML	3	Wr Ww	165	2,000	50	338	12.5	.....	11.28	15.3	1,625	390	2,523	118	100	1,700	45	750	13,200	Ms
Curtiss-Wright Airplane Co.	Moth	197	.....	OBL	2	Gy	90	1,950	35	540	7.0	.....	6.78	16.5	1,045	200	1,650	105	90	1,670	40	700	16,200	Ms
Curtiss-Wright Airplane Co.	CW-1Z	397	1,490	OML	2	Sz	45	1,825	85	200	3.3	75	5.5	21.6	555	187	975	80	70	.....	41	600	12,000	Ms
Curtiss-Wright Airplane Co.	CW-1Q	401	3,500	OBL	2	Wr Gy	90	1,950	33	484	4.6	84	8.4	19.1	1,071	268	1,725	103	88	.....	49	600	12,500	Ms
Curtiss-Wright Airplane Co.	CW-1K	406	4,288	OBL	2	K	125	1,925	33	400	7.5	96	8.6	14.3	1,164	246	1,800	117	98	.....	51	900	16,500	Ms
Curtiss-Wright Airplane Co.	CW-1W	407	4,455	OBL	2	War	110	1,850	33	410	5.5	94	8.6	16.2	1,186	224	1,800	117	98	.....	51	750	15,000	Ms
Curtiss-Wright Airplane Co.	CW-16K	411	4,488	OBL	3	K	125	1,925	33	400	7.5	96	9.5	15.6	1,176	383	1,950	115	96	.....	54	850	12,500	Ms
Davis Aircraft Corp.	D-1-70	256	2,695	OML	2	Lb	65	1,950	20	350	4.5	90	9.1	19.0	840	190	1,335	110	90	1,800	38	750	13,000	Ms
Davis Aircraft Corp.	D-1-K	272	2,795	OML	2	K	100	1,850	25	350	6.5	.....	10.1	14.6	925	197	1,461	125	105	1,700	40	1,000	16,000	Ms
Davis Aircraft Corp.	D-1-85	317	2,995	OML	2	Lb	85	2,125	20	350	5.0	.....	10.0	16.0	854	217	1,380	120	100	1,850	38	850	14,000	Ms
Detroit Aircraft Corp. (Parks)	P-1-Trainer	179	.....	OBL	3	OX-5	90	1,400	32	300	8.0	96	7.16	23.10	1,331	371	2,078	90	75	1,375	35	500	10,000	Ms
Detroit Aircraft Corp. (Ryan)	P-2-Speedster	200	.....	OBL	3	Ax	150	1,800	52	520	9.0	102	8.55	16.26	1,520	393	2,440	112	90	1,600	45	650	11,000	Ms
Detroit Aircraft Corp. (Ryan)	P-2-A Speedster	276	.....	OBL	3	Wr Ww	165	2,000	52	540	9.2	102	8.36	14.41	1,483	370	2,380	117	95	1,700	45	725	13,000	Ms
Driggs Aircraft Corp.	Skylark	303	2,775	OBL	2	Rover	75	1,975	22	300	5.0	84	7.4	18.4	878	501	1,379	105	85	1,800	45	650	14,000	Ms
Fleet Aircraft Inc.	I	122	.....	OBL	2	War	110	1,850	24	350	6.0	.....	8.1	14.37	1,035	211	1,580	106	90	1,650	46	730	13,200	Ms
Fleet Aircraft Inc.	II	131	.....	OBL	2	K	110	1,850	24	352	6.0	.....	8.08	14.32	1,023	218	1,575	106	90	1,650	46	730	13,200	Ms
Granville Bros. Aircraft, Inc.	Gee Bee Model E	398	5,230	OML	1	War	110	1,850	38	550	7	84	14.0	.....	912	50	1,400	155	128	1,750	55	1,400	20,000	Ms
Granville Bros. Aircraft, Inc.	Gee Bee Model D	404	4,980	OML	1	Men	125	2,175	38	550	7	84	14.0	.....	922	50	1,400	159	130	1,900	55	1,500	21,000	Ms
Great Lakes Aircraft Corp.	2-T-1A	228	2,985	OBL	2	Cir	90	2,100	26	370	6.3	78	8.43	17.53	1,016	223	1,580	107	90	1,825	50	550	8,000	Ms
Great Lakes Aircraft Corp.	2-T-1E	354	3,185	OBL	2	En	95	2,100	26	370	6.3	78	8.43	16.63	1,016	215	1,580	107	90	1,825	50	550	8,000	Ms
Inland Aviation Co.	S-300	259	3,485	OML	2	Lb	60	1,950	24	450	4.6	.....	8.97	19.9	765	195	1,292	100	90	1,850	44	850	13,000	Ms
Inland Aviation Co.	W-500	315	4,985	OML	2	War-7	110	1,975	31	500	7.0	.....	10.2	13.5	910	195	1,490	135	100	1,850	48	1,600	18,000	Ms
Inland Aviation Co.	R-400 Sportster	343	.....	OML	2	War-5	90	1,975	24	450	4.8	.....	10.2	16.3	902	235	1,466	120	90	.....	46	1,100	14,000	Ms
E. M. Laird Airplane Co.	LC-R-300	176	11,500	OBL	3	Wr Ww	300	2,000	76	550	.....	.....	15.3	10.3	1,922	390	3,010	165	135	.....	55	1,500	20,000	Ms
E. M. Laird Airplane Co.	LC-RJ-200	152	9,500	OBL	3	Wr Ww	220	.....	76	600	.....	.....	14.4	13.2	1,848	390	2,914	150	120	.....	55	1,200	18,000	Ms
E. M. Laird Airplane Co.	Whirlwind LC-B200	86	9,850	OBL	3	Wr Ww	220	.....	76	600	.....	.....	9.6	13.0	1,800	390	2,850	135	110	.....	45	1,200	19,000	Ms
E. M. Laird Airplane Co.	Whirlwind LC-B300	353	10,850	OBL	3	Ww	300	.....	76	550	.....	.....	10.3	10.1	1,930	390	3,020	150	120	.....	45	1,600	22,000	Ms
E. M. Laird Airplane Co.	Speedwing LC-RW	377	14,250	OBL	3	Pwj	300	.....	78	600	.....	.....	15.3	10.3	1,922	390	3,010	190	150	.....	58	1,600	22,000	Ms
Lincoln Aircraft, Inc.	PT	181	2,565	OBL	2	OX-5	90	1,400	29	300	8.0	.....	6.6	21.9	1,428	190	1,968	101	82	.....	37	600	11,000	Ms
Lincoln Aircraft, Inc.	PTK	279	3,865	OBL	3	K	90	1,825	28.5	400	.....	.....	6.0	19.6	1,176	220	1,767	104	85	.....	35	820	13,500	Ms
Lincoln Aircraft, Inc.	PTW	284	4,315	OBL	3	War	110	1,850	28.5	400	.....	.....	6.0	16.4	1,203	220	1,794	108	87	.....	35	870	14,000	Ms
Lincoln Aircraft, Inc.	AP-B-5	372	4,395	CML	3	K-B-5	125	1,950	30	450	8.0	.....	10.4	17.2	1,352	412	2,180	128	103	1,800	48	830	18,000	Ms
Lincoln Aircraft, Inc.	AP-K-5	373	5,995	CML	3	K-5	90	1,810	36	450	7.0	.....	10.4	21.5	1,320	412	2,148	112	97	1,700	48	500	11,000	Ms

Lincoln Aircraft, Inc.	AP-B-5	372	4,395	CML	3	K-B-5	125	1,950	36	450	8.0	.....	10.4	17.2	1,352	412	2,180	128	103	1,800	48	830	18,000	Ms
Lincoln Aircraft, Inc.	AP-K-5	373	5,995	CML	3	K-5	90	1,810	36	450	7.0	.....	10.4	21.5	1,320	412	2,148	112	97	1,700	48	500	11,000	Ms
Lincoln Aircraft, Inc.	PTT	344	3,360	OBL	2	Br	90	1,700	28.5	400	6.0	.....	6.0	18.5	1,164	240	1,662	102	85	1,600	38	650	13,000	Ms
Mercury Aircraft, Inc.	Chic	235	2,985	OML	2	Lb	90	2,050	28	375	7.0	.....	7.9	16.8	935	200	1,513	112	90	1,750	40	900	18,000	Ms
Mohawk Aircraft Corp.	M1-C-K Pinto	263	4,800	OML	2	K	90	1,825	37	450	7.2	.....	12.0	16.4	1,135	250	1,800	115	98	1,800	.....	1,100	15,000	Ms
Mohawk Aircraft Corp.	M-1-CW Pinto	297	5,100	OML	2	War	110	1,850	37	450	7.5	.....	12.0	16.4	1,135	250	1,800	121	108	1,925	.....	1,200	16,000	Ms
Mono Aircraft Corp.	Monoprep	218	2,835	CML	2	Lam	55	2,000	.....	.....	.....	.....	9.0	23.41	783	.....	1,288	.....	.....	.....	.....	.....	.....	.....
Mono Aircraft Corp.	Monocoupe 110	327	4,500	CML	2	War-7	110	1,850	30	450	8.0	.....	12.3	14.7	1,000	250	1,620	138	116	1,850	46	1,200	18,000	Ms
New Standard Aircraft Corp.	D-26-A	225	9,750	OBL	3	Wr Ww	220	2,000	62	500	12.4	.....	9.55	15.5	2,055	765	3,400	110	95	1,700	38	750	14,000	Ms
New Standard Aircraft Corp.	D-29-A	216	4,185	OBL	2	K-5	100	1,810	22	290	7.2	.....	7.32	17.9	1,165	300	1,799	98	75	1,600	42	500	10,800	Ms
New Standard Aircraft Corp.	D-29-B	324	5,000	OBL	2	KB-5	125	1,925	38	380	9.0	.....	7.55	14.8	1,195	234	1,850	108	85	1,600	45	650	12,000	Ms
Nicholas-Beasley Airplane Co.	NB-4-L	385	.....	OML	3	Lam	90	2,375	24	390	5.5	.....	9.52	16.82	828	350	1,511	109	93	1,825	48	850	16,000	Gt
Nicholas-Beasley Airplane Co.	NB-4-W	386	.....	OML	3	War	90	2,025	24	390	5.5	.....	9.75	17.15	860	350	1,544	109	93	1,825	48	850	16,000	Gt
Pitcairn Aircraft, Inc.	P-7	196	8,000	OBL	3	Wr Ww	225	1,800	71	.....	.....	.....	.....	.....	1,821	636	3,050	145	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-C	232	6,750	OBL	3	Cu Ch	170	1,800	55	500	10.0	.....	.....	.....	1,495	355	2,380	.....	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc.	2000-CO	314	6,500	OBL	3	Con	165	2,000	55	500	10.0	.....	.....	.....	1,447	370	2,359	.....	.....	.....	.....	.....	.....	Ms
Simplex Aircraft Corp.	Red Arrow K-28	43	3,150	OML	2	K	90	1,825	44	.....	6.5	.....	11.8	19.0	1,152	170	1,779	125	110	1,700	48	1,000	12,000	Ms
Simplex Aircraft Corp.	Red Arrow W-28	238	3,250	OML	2	War	110	1,850	44	.....	7.8	.....	11.8	16.0	1,150	170	1,779	125	110	1,700	48	1,200	14,000	Ms
Sioux Aircraft Corp.	Coupe-90	331	3,365	CML	2	Lam	90	2,375	27	400	6.5	.....	.....	.....	975	200	1,535	105	90	2,150	40	700	9,000	Ms
Spartan Aircraft Co.	C-3-165	195	5,975	OBL	3	Wr Ww	165	2,000	65	600	10.0	102	9.0	15.85	1,650	370	2,612	121	100	1,750	47	820	12,000	Ms
Spartan Aircraft Co.	C-3-225	286	7,750	OBL	3	Wr Ww	240	2,000	60	496	13.0	104	9.29	12.0	1,740	390	2,700	133	110	1,750	50	1,160	15,000	Gt
Star Aircraft Co.	Cavalier C	255	2,985	CML	2	Lb	60	1,950	22	400	.....	.....	9.0	21.5	855	200	1,400	100	90	.....	38	800	16,000	Ms
Star Aircraft Co.	Cavalier E	321	3,450	OML	2	Lam	.....	.....	22	400	.....	.....	9.07	15.83	919	185	1,425	.....	.....	.....	.....	.....	.....	Ms
States Aircraft Corp.	S-E-5F	349	3,645	OML	2	K	100	1,950	25	.....	5.5	.....	8.0	16.35	1,083	220	1,635	105	90	1,750	35	900	14,000	Ms
Swallow Airplane Co.	T-P	105	2,878	OBL	3	OX-5	90	1,400	28	300	8.0	.....	6.2	20.25	1,280	180	1,825	90	80	1,350	43	700	16,000	Ms
Swallow Airplane Co.	F-28-AX	125	.....	OBL	3	Ax	150	1,800	62	600	8.0	.....	8.3	16.6	1,574	340	2,497	110	90	1,625	42	800	14,000	Ms
Swallow Airplane Co.	TP-K	186	.....	OBL	3	K	90	1,825	28	350	7.5	.....	5.75	19.0	1,170	170	1,700	100	85	1,650	42	800	16,500	Ms
Swallow Airplane Co.	TP-W	253	.....	OBL	3	War	110	1,850	28	350	7.5	.....	5.8	15.5	1,201	170	1,739	100	85	1,650	42	800	10,500	Ms
United-Boeing Airplane Co.	Boeing 100	133	20,000	OBL	1	Pww	450	1,800	97	525	20.0	.....	11.8	5.97	1,882	60	2,750	165	140	1,600	55	.....	.....	Ms
United-Stearman	C-3R	251	8,500	OBL	3	Wr Ww	225	2,000	68	605	12.0	.....	9.56	11.47	1,741	400	2,754	133	110	1,700	47	1,000	16,000	Ms
United-Stearman	4-E	292	16,000	OBL	3	Pww	420	2,000	106	650	21.0	.....	12.82	9.37	2,426	629	3,936	158	130	1,700	55	1,400	18,000	Ms
United-Stearman	4-C	304	12,500	OBL	3	Wr Ww	300	2,000	106	835	15.0	.....	12.38	12.67	2,256	663	3,800	145	118	1,700	55	1,000	15,000	Ms
United-Stearman	4-D	305	12,500	OBL	3	Pwj	300	2,000	106	815	15.0	.....	12.38	12.67	2,297	622	3,800	143	115	1,700	55	1,000	15,000	Ms
United-Stearman	6-A	365	.....	OBL	2	Wr Ww	165	2,000	37	395	8.2	.....	8.90	14.54	1,733	256	2,400	110	88	1,700	51	710	12,300	Gt
United-Stearman	6-F	371	.....	OBL	2	Con	165	2,000	37	395	8.2	.....	8.90	14.54	1,727	262	2,400	110	88	1,700	51	710	12,300	Ms
United-Stearman	6-D	402	.....	OBL	2	Pwj	300	2,000	65	490	15.0	108	10.34	9.38	1,925	265	2,814	137	113	1,700	55	1,250	18,100	Gt
Verville Aircraft Co.	Sport Trainer	323	5,250	OBL	2	Con	165	2,000	36	380	9.0	.....	9.27	13.6	1,562	.....	.....	120	95	1,800	40	850	15,000	Ms
Viking Flying Boat Co.	Kittyhawk B-2	134	4,650	OBL	3	Y	113	1,710	35	500	6.5	.....	8.15	18.1	1,139	357	1,899	110	95	1,600	38	1,200	15,000	Ms
Viking Flying Boat Co.	Kittyhawk B-4	166	4,250	OBL	3	K	110	1,810	35	500	6.5	.....	8.05	18.8	1,107	362	1,875	110	95	1,650	38	1,200	15,000	Ms
Viking Flying Boat Co.	Kittyhawk B-8	392	4,250	OBL	3	K	125	1,900	35	425	7.5	98	8.37	15.60	1,164	383	1,950	106	90	1,700	38	1,000	16,000	Ms
Waco Aircraft Co.	HSO	333	7,500	OBL	3	Pdd	225	1,900	65	700	9.0	.....	9.03	10.8	1,814	.....	2,600	124	105	.....	.....	1,000	18,000	Ms
Waco Aircraft Co.	QSO	337	5,575	OBL	3	Con	165	2,000	65	650	10.0	.....	9.0	15.6	1,585	.....	2,600	116	98	.....	.....	800	16,000	Ms
Waco Aircraft Co.	INF	345	4,365	OBL	3	KB-5	125	1,900	32	400	8.0	.....	7.7	.....	1,150	.....	.....	118	98	1,750	.....	950	18,000	Ms
Waco Aircraft Co.	PSO	339	5,175	OBL	3	Jac	140	1,800	65	625	9.0	.....	8.5	17.4	1,508	.....	2,441	106	95	1,750	.....	600	12,000	Ms
Waco Aircraft Co.	BSO	168	6,370	OBL	3	Wr Ww	165	2,000	65	625	10.0	.....	9.03	15.75	1,529	.....	2,600	120	100	.....	.....	700	18,000	Ms
Waco Aircraft Co.	CSO	240	7,335	OBL	3	Wr Ww	240	2,000	65	600	12.0	.....	9.03	11.5	1,620	.....	2,600	128	105	.....	.....	1,200	19,000	Ms
Waco Aircraft Co.	CTO	257	8,525	OBL	3	Wr Ww	240	2,000	65	650	12.0	.....	11.45	11.5	1,677	.....	2,600	138	115	1,750	48	1,500	19,000	Ms
Waco Aircraft Co.	RNF	311	4,250	OBL	3	War	110	1,850	32	400	8.0	.....	7.8	17.2	1,110	.....	1,900	.....	.....	.....	.....	.....	.....	Ms
Waco Aircraft Co.	KNF	313	4,100	OBL	3	K	100	1,810	32	385	7.0	.....	7.8	17.2	1,095	.....	1,900	.....	.....	.....	.....	.....	.....	Ms
Waco Aircraft Co.	QCF	416	4,985	OBL	3	Con	165	2,000	40	.....	.....	.....	9.1	13.31	1,288	478	2,200	124	108	1,850	42	1,050	16,000	Ms
Waco Aircraft Co.	MNF	393	4,677	.....	3	Men	125	2,175	32	.....	8.0	86	7.9	15.2	1,155	360	1,900	113	95	2,000	38	600	14,000	Ms

CARGO PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS

Curtiss Aeroplane & Motor Co.	Carrier Pigeon	237	.....	OBL	1	Cu Cq	600	2,400	.....	.....	.....	.....	13.82	11.96	4,235	.....	7,600	.....	.....	.....	.....	.....	.....	.....
Detroit-Lockheed Aircraft Co.	Sirius 8	300	.....	OML	2	Pww	420	2,000	150	980	21.5	.....	16.7	10.95	2,978	Var	4,600	173	140	1,700	60	1,200	20,000	Gt
Detroit-Lockheed Aircraft Co.	Sirius DL-2	378	.....	OML	2	Pww	420	2,000	140	940	21.5	.....	18.8	12.30	2,958	1,106	5,170	175	143	1,700	61	1,100	18,000	Gt
New Standard Aircraft Corp.	D-27-A	226	9,750	OBL	1	Ww-7	220	2,000	62	500	12.4	.....	9.55	15.5	2,055	765	3,400	110	95	1,700	38	750	14,000	Ms
Pitcairn Aircraft, Inc.	PA-8, Mailwing	364	12,500	OBL	1, 3	Ww, Pwj	300	2,000	70	.....	.....	.....	13.9	13.3	2,270	1,030	4,000	.....	.....	.....	.....	.....	.....	.....
United-Stearman Aircraft Co.	4-EM, Speedmail	322	16,000	OBL	1	Pww	420	2,000	106	645	21.0	.....	12.82	9.37	2,455	600	3,936	158	130	1,700	55	1,400	18,000	Ms
United-Stearman Aircraft Co.	4-DM, Speedmail	325	12,500	OBL	1	Ww	300	2,000	106	835	15.0	.....	12.82	13.12	2,285	770	3,936	145	118	1,700	55	1,000	15,000	Ms
United-Stearman Aircraft Co.	4-DM, Speedmail	326	12,500	OBL	1	Pwj	300	2,000	106	815	15.0	.....	12.82	13.12	2,326	729	3,936	143	115	1,700	55	1,000	15,000	Ms

A	—Amphibion	Br	—Brownback	Cu	—Curtiss	Gt	—Gov't test	L	—Landplane	Na	—Navigation	Pwj	—P & W Wasp Jr.	Sh	—Sheet	W	—Wood								
Acp	—Aircraft Products	Bx	—Bendix	Cv	—Conventional	Gy	—Gipsy	La-l	—Ace	O	—Open	Pww	—P & W Wasp	Sk	—Stick	Wa	—Walter								
Ad	—Alclad	C	—Closed	Cy	—Cyclone	H	—Hamilton	Lam	—Lambert	Ol	—Oleo	Q	—Sesquiplane	Sol	—Solid	War	—Warner								
Aer	—Aerol	Ca	—Cable	D	—Duralumin	He	—Henderson	Lb	—LeBlond	Old	—Oildraulic	R	—Rubber	Sp	—Spruce	Wat	—Warren Truss								
Al	—Axle	Can	—Cantilever	Dep	—Deperdussin	His	—Hispano	Li	—Liberty	Op	—Optional	Ret	—Retractable	Spl	—Split	We	—Westinghouse								
Amer	—American	Cd	—Cord	Du	—Dual	Ht	—Heat treated	Lk	—Lockheed	OX-5	—Curtiss	Ro	—Routed	St	—Standard	Wh	—Wheel								
Apl	—Applied	Cg	—Corrugated	En	—Ensign	Hw	—Hess Warrior	Lmd	—Laminated	P	—Paragon	Rr	—Ranger	Str	—Straight	Wi	—Wire								
Aw	—Air Wheels	Ch	—Challenger	Ex	—Extra	Hyd	—Hydraulic	Lr	—LeRhone	Pe	—Pedal	Rus	—Rusco	Su	—Supreme	Wl	—Welded								
Ax	—Axelson	Cir	—Cirrus	F	—Flying boat	I	—"I" section	Ly	—Lycoming	Pdd	—Packard Diesel	Rv	—Riveted	Sy	—Story	Wr	—Wright								
B	—Biplane	Co	—Comet	Fab	—Fabric	In	—Internal	M	—Monoplane	Pk	—P-K screws	S	—Steel	Sa	—Sausedde	Wt	—Wind Tunnel								
Bak	—Bakelite	Com	—Compression	G	—Glued	Ir	—Irwin	Me	—Metal	Ply	—Plywood	Sc	—Shock Cord	T	—Tubing	Ww	—New Whirlwind								
Be	—Beam	Con	—Continental	Ge	—Genet	Ja	—Jacobs	Men	—Menasco	Pn	—Pneumatic	Scd	—Screwed	Tr	—Trombone	Y	—Yankee								
Bo	—Bolted	Cq	—Conqueror	Go	—Goodyear	K	—Kinner	Mo	—Monocoque	Pr	—Push Rod	Sd	—Stamped	Tred	—Treadle	Z	—Seaplane								
Box	—Box spar	Cs	—Coiled Springs	Gr	—Gruss	Kh	—Kelsey-Hayes	Ms	—Mfr's statement	Pwh	—P & W Hornet			Trs	—Truss	*	—Without engine								

Table 2: American landplane specifications

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

CONTINUED ON PAGE 431

Manufacturer	Designation	A. T. C. No.	Price at Factory	Type	No. of Seats	Make of Engine	Total Rated Hp.	R.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed, Gal. per Hr.	Diameter of Propeller, in.	Wing Loading (Lb. per Sq.Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Liquid if Used	Pay Load (Lbs.)	Gross Weight (Lbs.)	High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
SINGLE-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																								
Alexander Aircraft Co.	C-7 Bullet	318	6,500	OML	4	Ww	165	2,000	44	560	9.0	...	13.3	16.9	1,720	610	2,780	148	124	1,675	45.0	700	17,000	...
American Airp. & Eng. Corp.	Pilgrim 100	390	...	CML	9	Pwh	575	1,950	120	450	34.0	124	15.6	11.3	3,700	1,820	6,500	142	122	1,750	63.0	900	18,000	Ms
American Airp. & Eng. Corp.	Pilgrim 71	89	...	CML	7	Pww	420	2,000	148	748	21.0	108	17.7	13.1	2,940	1,427	5,500	133	106	1,700	63.8	790	14,150	Ms
American Airp. & Eng. Corp.	Pilgrim 71-A	289	...	C - L	7	Pww	420	2,000	148	748	21.0	114	17.7	12.2	3,156	1,206	5,500	133	106	1,700	63.8	790	14,150	Ms
American Airp. & Eng. Corp.	Pilgrim 42	242	...	CML	4	Wr Ww	300	2,000	105	515	18.0	108	15.6	14.1	2,676	710	4,246	129	103	1,700	59.0	598	13,100	Ms
American Airp. & Eng. Corp.	Pilgrim 51	286	...	CML	5	Wr Ww	300	2,000	80	495	18.0	108	14.7	14.7	2,356	904	4,000	131	105	1,700	57.0	730	15,500	Ms
American Airp. & Eng. Corp.	Pilgrim 51-A	358	...	CML	5	Pwj	300	2,000	140	495	18.0	108	14.7	14.7	2,440	Var	3,920	132	106	1,700	57.0	710	15,000	Ms
American Eagle Aircraft Co.	C-430	320	5,995	CML	4	Con	165	1,850	60	700	9.0	...	...	...	1,875	550	3,008	...	...	...	...	...	...	...
American Eagle Aircraft Co.	D-430	301	6,395	CML	4	Ww	165	1,850	60	700	9.0	...	...	...	1,864	550	2,997	125	109	1,775	38.0	850	16,000	Ms
Bellanca Aircraft Corp.	Pacemaker	129	15,150	CML	6	Ww	300	2,000	112	850	16.0	108	...	...	2,363	1,050	4,300	150	125	...	...	900	17,000	Ms
Bellanca Aircraft Corp.	Pacemaker	328	15,550	CML	6	Pwj	300	2,000	112	850	16.0	108	...	...	2,465	933	4,300	150	125	1,800	...	900	17,000	Ms
Bellanca Aircraft Corp.	Freighter	245	15,150	CML	4	Ww	300	2,000	86	600	16.0	108	...	...	2,290	1,570	4,600	150	124	1,800	...	750	15,000	Ms
Bellanca Aircraft Corp.	Skyrocket	319	17,950	CML	6	Pww	420	2,000	120	750	21.0	110	...	...	2,592	1,058	4,600	155	130	1,700	...	1,250	20,000	Ms
Bellanca Aircraft Corp.	Airbus	360	38,500	CML	12	Cu Cq	600	2,450	200	750	33.0	147	14.2	15.8	5,490	2,572	9,500	147	126	2,150	...	750	16,000	Ms
Bellanca Aircraft Corp.	Airbus	391	32,900	CML	12	Wr Cy	575	1,900	200	750	31.0	118	...	...	5,155	2,945	9,590	139	120	...	...	600	13,000	Ms
Buhl Aircraft Co.	CA-6	128	13,500	CQL	6	Ww	300	2,000	100	720	16.0	...	14.3	15.0	2,478	1,192	4,500	140	120	1,750	45.0	900	15,000	Ms
Buhl Aircraft Co.	CA-8-A	98	19,500	CQL	8	Cy	525	1,900	181	775	28.0	...	13.6	18.0	3,542	1,390	6,300	145	115	1,700	45.0	1,000	18,000	Ms
Buhl Aircraft Co.	CA-8-B	99	19,500	CQL	8	Pwh	525	1,950	181	775	28.0	...	13.6	12.0	3,542	1,390	6,300	145	115	1,700	45.0	1,000	18,000	Ms
Cessna Aircraft Co.	DC-6-A	243	11,000	CML	4	Ww	300	2,000	66	...	13.0	...	11.9	10.6	1,932	610	3,180	161	130	1,700	54.0	1,400	19,000	Ms
Cessna Aircraft Co.	DC-6-B	244	9,750	CML	4	Ww	225	2,000	66	...	11.0	...	11.6	13.8	1,871	610	3,100	148	120	1,700	52.0	900	17,000	Ms
Consolidated Aircraft Co.	Fleetster 17	291	...	CML	8	Pwh	575	1,950	150	500	30.0	...	17.9	9.8	3,326	1,414	5,600	175	150	1,700	65.0	1,200	18,000	Ms
Consolidated Aircraft Co.	Fleetster 17-20	369	...	CML	8	Wr Cy	575	1,950	146	700	32.0	...	17.8	9.8	3,443	1,325	5,600	180	153	1,950	64.0	1,050	19,000	Gt
Consolidated Aircraft Co.	Fleetster 20	320	...	CML	6	Pwh	575	1,950	150	500	30.0	...	18.8	10.3	3,439	1,600	5,900	165	140	1,700	65.0	1,100	17,500	Ms
Curtiss-Wright Airplane Co.	4-C-1-A	309	7,995	CML	4	Cu Ch	185	1,800	50	481	10.1	66	12.8	15.6	1,811	531	2,850	115	98	1,530	58.0	505	11,200	Ms
Curtiss-Wright Airplane Co.	6-B	352	...	CML	6	Ww	300	2,000	90	560	18.0	108	15.9	15.0	2,739	950	4,452	144	115	1,800	66.0	900	16,000	Ms
Detroit-Lockheed Aircraft Corp.	Vega Model 5B	227	...	CML	7	Pww	420	2,000	100	700	21.5	108	16.4	10.7	2,595	...	4,500	180	150	1,700	60.0	1,275	19,000	Ms
Detroit-Lockheed Aircraft Corp.	Vega DL-1	308	...	CML	7	Pww	420	2,000	100	700	21.5	108	16.4	10.7	2,595	Var	4,500	178	150	1,700	59.0	1,345	19,750	Gt
Detroit-Lockheed Aircraft Corp.	Air Express	102	...	CML	5	Pww	420	2,000	100	675	21.5	108	14.8	10.4	2,533	1,012	4,375	175	147	1,700	58.0	1,200	20,000	Ms
Detroit-Lockheed Aircraft Corp.	Orion	421	...	CML	7	Pww	450	2,100	125	600	29.0	108	18.7	11.5	3,250	Var	5,200	215	180	1,800	64.0	1,430	21,600	Ms
Detroit-Ryan Corp.	P-5	142	...	CML	6	Ww	300	2,000	100	710	15.6	108	14.7	13.3	2,251	923	4,000	138	110	1,700	60.0	1,000	16,000	Ms
Detroit-Ryan Aircraft Corp.	B-7	262	...	CML	6	Pww	420	2,000	100	540	21.5	111	15.7	10.2	2,503	950	4,283	144	116	1,700	61.0	1,060	16,350	Gt
Detroit-Ryan Aircraft Corp.	Foursome	346	...	CML	4	Ww	240	2,000	70	615	12.0	108	14.0	13.9	2,133	568	3,350	128	105	1,700	55.0	800	14,000	Ms
Fokker Aircraft Corp.	Universal	164	11,000	CML	7	Ww	300	2,000	79	535	15.5	108	12.6	14.3	2,482	1,099	4,300	130	105	1,700	52.0	800	14,000	Ms
Fokker Aircraft Corp.	AF-14	234	22,500	CML	9	Pwh, Cy	525	1,900	170	730	27.0	120	13.1	13.7	4,245	1,652	7,200	137	120	1,650	42.0	710	14,300	Gt
Fokker Aircraft Corp.	Super Universal	52	17,500	CML	8	Pww	420	2,000	120	675	21.0	114	14.3	13.2	3,250	1,320	5,550	138	118	1,650	56.0	850	18,000	Ms
Mono Aircraft Corp.	Monocoach	275	8,250	CML	4	Ww	225	2,000	...	...	...	...	13.9	13.7	1,919	750	3,042	133	112	...	...	1,200	18,000	Ms
New Standard Aircraft Corp.	D-25-A	224	9,750	OBL	5	Ww	220	2,000	62	500	12.4	...	9.6	15.0	2,055	710	3,345	110	95	1,700	38.0	750	14,000	Ms
Northrop Aircraft Corp.	Alpha	381	21,500	CML	7	Pww	420	2,000	85	700	21.0	113	15.3	10.7	2,678	1,022	4,500	170	140	1,800	60.0	1,400	19,300	Ms
Spartan Aircraft Co.	C4-225	310	9,750	CML	4	Ww	240	2,000	85	615	15.0	104	11.75	14.7	2,325	Var	3,515	130	109	1,800	51.0	905	15,000	Ms
Spartan Aircraft Co.	C4-300	383	11,700	CML	4	Ww	300	2,000	85	631	16.0	104	13.2	13.2	2,567	660	3,965	143	122	1,800	56.0	990	15,400	Ms
Spartan Aircraft Co.	C4-301	394	11,900	CML	4	Pwj	300	2,000	85	631	16.0	104	13.5	13.5	2,597	660	3,995	145	124	1,800	56.0	965	15,200	Ms
Spartan Aircraft Co.	C5-301	389	12,900	CML	5	Pwj	300	2,000	85	620	16.0	104	13.9	13.9	2,607	830	4,175	145	124	1,800	57.5	940	14,600	Ms
Stinson Aircraft Corp.	SM-7B	329	8,995	CML	4	Pwj	300	1,950	90	450	20.0	...	14.9	11.7	2,312	...	3,500	...	...	...	...	...	...	...
Stinson Aircraft Corp.	S-Jr.	423	4,995	CML	4	Ly	215	2,000	55	450	12.0	102	13.9	15.3	2,152	510	3,265	125	105	1,800	52.0	650	15,000	Ms
United-Boeing Airplane Co.	40-B-4	183	22,500	CBL	4	Pwh	525	1,900	140	450	25.0	...	11.2	11.6	3,809	1,171	6,080	138	110	1,600	58.0	800	16,500	Ms
United-Boeing Airplane Co.	221	366	...	CML	7	Pwh	575	1,950	135	500	34.0	...	15.0	13.9	4,990	1,930	8,000	158	137	1,700	...	850	14,000	Ms
United-Stearman Aircraft Co.	LT-1	187	25,000	CBL	5	Pwh	525	2,000	145	610	26.2	...	12.8	11.9	3,890	1,215	6,250	140	110	1,700	58.0	900	15,000	Ms
Waco Aircraft Co.	QDC	412	5,985	CBL	4	Con	165	2,000	40	...	...	...	10.6	15.7	1,512	638	2,600	116	105	1,850	48.0	700	14,000	Ms
MULTI-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																								
Curtiss Aeroplane & Motor Co.	Condor	193	...	CBL	21	2 Cu Cq	1,200	2,400	278	...	...	...	11.5	14.50	11,352	3,600	17,378	...	116	...	...	870	17,000	MS
Curtiss-Wright Airplane Co.	Kingbird D-1	347	23,333	CML	8	2Ww	480	2,000	130	454	25.4	106	15.1	12.73	3,754	1,230	6,115	130	112.5	1,700	62.0	820	14,700	MS
Curtiss-Wright Airplane Co.	Kingbird D-2	348	25,555	CML	8	2Ww	600	2,000	130	415	36.0	106	15.1	10.20	3,877	1,230	6,115	142	120	1,700	63.0	1,000	18,000	MS
Curtiss-Keystone Aircraft Corp.	Patrician	260	...	CML	20	3 Cy, 3 Pwh	1,575	1,900	335	720	90.0	132	17.9	10.50	10,200	3,662	16,600	144	120	...	59.0	1,080	14,500	MS
Fokker Aircraft Corp.	AF-10A	96	54,500	CML	14	3 Pww	1,260	2,000	360	755	60.0	102	16.5	11.1	8,500	2,700	14,000	153	126	1,700	60.0	1,100	18,000	Gt

Manufacturer	Designation	A. T. C. No.	Price at Factory	Type	No. of Seats	Make of Engine	Total Rated Hp.	R.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed	Diameter of Propeller, in.	Wing Loading (Lb. per Sq.Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Liquid if Used	Pay Load (Lbs.)	Gross Weight (Lbs.)	High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
Fokker Aircraft Corp.	AF-10A	96	54,500	CML	14	3 Pww	1,260	2,000	360	755	60.0	102	16.5	11.1	8,500	2,700	14,000	153	126	1,700	60.0	1,100	18,000	Gt
Fokker Aircraft Corp.	AF-32	281	110,000	CML	32	4 Pwh	2,300	1,950	700	770	112.0	120;102	18.3	10.60	15,080	4,105	24,250	146	123	1,650	63.0	850	13,000	Ms
Ford Motor Co.	4-AT-E	132	.....	CML	14	3 Ww, Pwj	900	2,000	231	580	45.0	108	12.9	11.25	6,500	1,725	10,130	138	113	1,700	57.0	920	16,500	Ms
Ford Motor Co.	5-AT-D	409	.....	CML	16	3 Pww	1,260	2,000	277	550	60.0	120	16.8	11.1	8,140	3,610	14,000	150	120	1,700	65.0	975	17,500	Ms
Ford Motor Co.	7-A	246	.....	CML	15	2 Ww, 1 Pww	1,020	2,000	281	635	50.0	120	15.5	12.60	7,280	3,380	12,910	138	113	1,700	60.0	880	14,100	Ms
Ogden Aeronautical Corp.	Osprey C	332	16,000	CML	6	3 Cir	270	2,000	90	500	18.0	78	14.4	16.70	2,850	949	4,548	130	105	1,850	65.0	650	15,000	Ms
Stinson Aircraft Corp.	SM-6000	335	25,900	CML	11	3 Ly	645	2,000	120	.....	34.5	.....	17.3	13.5	5,475	2,022	8,600	.....	.....	.....	.....	.....	.....	.....

Table 3: Amphibions and flying boats

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

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Manufacturer	Designation	A. T. C. No.	Price at Factory	Type	No. of Seats	Make of Engine	Total Rated Hp.	R.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed	Diameter of Propeller, in.	Wing Loading (Lb. per Sq.Ft.)	Power Loading (Lb. per Hp.)	Weight Empty with Cooling Liquid if Used	Pay Load (Lbs.)	Gross Weight (Lbs.)	High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stalling Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
		GENERAL				**POWER PLANT**							**WEIGHTS**					**PERFORMANCE**						
American Aeronautical Corp.	S-56	287	5,500	OBA	2	K	90	1,860	28	250	7.0	.....	7.5	21.5	1,447	365	2,150	86	75	1,700	42.0	400	6,500	Ms
American Aeronautical Corp.	S-31	336	6,200	OBA	3	K	125	1,900	28	300	7.0	.....	7.7	17.7	1,492	388	2,218	101	85	1,800	34.0	700	10,500	Ms
Amphibions, Inc.	Ireland N-2B	153	.....	CBA	4	Ww	300	2,000	80	450	15.0	108	11.4	10.4	2,900	600	4,300	105	85	1,700	42.0	600	.....	Ms
Amphibions, Inc.	Ireland N-2C	248	.....	CBA	5	Pww	420	2,000	80	450	18.0	108	13.0	11.5	3,240	900	4,900	120	95	1,700	48.0	900	.....	Ms
Amphibions, Inc.	Privateer	370	5,800	OMA	2	War	110	1,850	30	280	8.0	97	10.5	19.0	.....	210	2,100	95	75	1,850	41.0	550	.....	Ms
Consolidated Aircraft Co.	Commodore	258	.....	CMF	25	2 Pwh	1,150	1,950	650	1,000	60.0	.....	15.8	15.3	10,410	5,300	17,600	128	104	1,700	.....	600	10,000	Ms
C.W.-Keystone Aircraft Co.	Air Yacht	90	.....	CBA	8	Cy, Pwh	525	1,900	140	525	28.0	108	12.1	11.9	3,895	1,150	6,300	130	105	.....	55.0	850	13,800	Ms
C.W.-Keystone Aircraft Co.	Commuter	219	16,800	CBA	4	Ww	300	2,000	70	400	15.0	108	9.5	13.8	2,850	640	4,150	112	87	.....	50.0	850	12,000	Ms
Detroit-Eastman Aircraft Corp.	E-2, Sea Rover	288	.....	OQF	4	Cu Ch	185	2,000	48	350	11.5	102	11.2	14.8	1,745	.....	2,725	110	80	1,620	50.0	550	10,000	Ms
Detroit-Eastman Aircraft Corp.	E-2-A	338	.....	OQA	3	Cu Ch	185	2,000	48	350	11.5	102	11.2	14.8	1,970	.....	2,725	102	80	1,620	50.0	550	9,000	Ms
Douglas Aircraft Co.	Dolphin	422	35,000	CMA	8	2Wr Ww	600	2,000	180	720	30.0	108	14.6	13.7	5,625	15.00	8,200	146	120	1,700	60.0	875	16,200	Ms
Fokker Aircraft Corp.	AF-11A	222	33,775	CMA	7	Pwh, Cy	575	1,900	120	430	28.0	112	13.7	12.5	5,065	1,155	7,200	115	100	1,650	55.0	700	11,000	Ms
United-Boeing Airplane Co.	204	157	15,000	CBF	5	2 Pww	450	1,900	80	350	20.0	.....	10.6	12.2	3,358	913	5,000	133	110	1,625	50.0	.....	.....	Ms
United-Sikorsky Aviation Corp.	S-38	126	.....	CQA	10	2 Pww	840	2,000	330	.....	44.0	.....	14.3	12.3	6,550	.....	10,430	128	110	1,650	55.0	750	18,000	Ms
United-Sikorsky Aviation Corp.	S-38	356	.....	CQA	10	Pwh	1,150	1,950	330	.....	.....	.....	14.3	.....	.....	.....	10,430	.....	.....	.....	.....	.....	.....	.....
United-Sikorsky Aviation Corp.	S-39	375	.....	CMA	5	Pwj	300	2,000	65	350	17.0	.....	11.4	13.3	2,678	.....	4,000	120	100	1,750	54.0	750	16,000	Ms
United-Sikorsky Aviation Corp.	S-41	418	.....	CMA	13	2 Pwh	1,150	2,000	520	.....	60.0	.....	17.5	11.1	8,072	Var	12,800	131	115	1,750	60.0	875	18,200	Ms
Viking Flying Boat Co.	V-2	361	12,000	OBF	4	Ww	240	2,000	60	400	12.0	.....	8.6	14.4	2,300	582	3,450	105	90	1,750	46.0	750	14,000	Ms

A —Amphibion	Br —Brownback	Cu —Curtiss	Gt —Gov't test	L —Landplane	Na —Navigation	Pwj —P & W Wasp Jr.	Sh —Sheet	W —Wood
Acp —Aircraft Products	Bx —Bendix	Cv —Conventional	Gy —Gipsy	La-l —Ace	O —Open	Pww —P & W Wasp	Sk —Stick	Wa —Walter
Ad —Alclad	C —Closed	Cy —Cyclone	H —Hamilton	Lam —Lambert	Ol —Oleo	Q —Sesquiplane	Sol —Solid	War —Warner
Aer —Aerol	Ca —Cable	D —Duralumin	He —Henderson	Lb —LeBlond	Old —Oildraulic	R —Rubber	Sp —Spruce	Wat —Warren Truss
Al —Axle	Can —Cantilever	Dep —Deperdussin	His —Hispano	Li —Liberty	Op —Optional	Ret —Retractable	Spl —Split	We —Westinghouse
Amer—American	Cd —Cord	Du —Dual	Ht —Heat treated	Lk —Lockheed	OX-5—Curtiss	Ro —Routed	St —Standard	Wh —Wheel
Apl —Applied	Cg —Corrugated	En —Ensign	Hw —Hess Warrior	Lmd —Laminated	P —Paragon	Rr —Ranger	Str —Straight	Wi —Wire
Aw —Air Wheels	Ch —Challenger	Ex —Extra	Hyd —Hydraulic	Lr —LeRhone	Pe —Pedal	Rus —Rusco	Su —Supreme	Wl —Welded
Ax —Axelson	Cir —Cirrus	F —Flying boat	I —"I" section	Ly —Lycoming	Pdd —Packard Diesel	Rv —Riveted	Sy —Story	Wr —Wright
B —Biplane	Co —Comet	Fab —Fabric	In —Internal	M —Monoplane	Pk —P-K screws	S —Steel	Sz —Szekely	Wt —Wind Tunnel
Bak —Bakelite	Com —Compression	G —Glued	Ir —Irwin	Me —Metal	Ply —Plywood	Sa —Sausedde	T —Tubing	Ww —New Whirlwind
Be —Beam	Con —Continental	Ge —Genet	Ja —Jacobs	Men —Menasco	Pn —Pneumatic	Sc —Shock Cord	Tr —Trombone	Y —Yankee
Bo —Bolted	Cq —Conqueror	Go —Goodyear	K —Kinner	Mo —Monocoque	Pr —Push Rod	Scd —Screwed	Tred —Treadle	Z —Seaplane
Box —Box spar	Cs —Coiled Springs	Gr —Gruss	Kh —Kelsey-Hayes	Ms —Mfr's statement	Pwh —P & W Hornet	Sd —Stamped	Trs —Truss	* —Without engine

Table 1: American landplane specifications

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

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Manufacturer and Designation	A.T.C. Nos.	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Framework			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How Fabricated	Material	How Fabricated	Covering Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Vol. Baggage Compartment, Cu. Ft.
PASSENGER PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Aeromarine Klemm	121, 204, 334	40′ 2″	24′ 6″	7′ 0″	194.5	18.3	3.8	6.5	17.2	14.0	W	Box	W	Ply	Ply	Spl	85	Aw 20x 9	No	Old	No	W	.....	Ply,Fab	6.0
Aeronautical Corp. Aeronca	351, 396	36′ 0″	20′ 0″	7′ 0″	126.5	7.9	6.7	10.0	7.5	6.2	Sp	Sol	Sp	G	Fab	Spl	60	Go 16x 7	No	Sp	No	ST	Wl	Fab	3.0
Alexander Eaglerock	58, 139, 190, 141, 57...	36′ 8″	25′ 11″	9′ 10″	330	42.6	4.2	10.2	23.8	16.8	W	Lmd, I	W	Trs	Fab	Spl	72	Kh-Var	Ex	Cd	....	ST	Wl	Fab	5.9
Amer. Airp. & Eng. Pilgrim KR-21	215, 368	27′ 0″	21′ 1″	8′ 6″	175.7	16.9	4.4	5.5	12.9	8.6	Sp	Sol	Sp	G	Fab	Spl	61	Kh 24x 4	Yes	Ol Spr	No	ST	Wl	Fab	2.75
Amer. Airp. & Eng. Pilgrim KR-34	162, 376	30′ 0″	23′ 2″	8′ 9″	248	36.4	4.5	7.5	27.4	16.9	Sp	Sol	Sp	G	Fab	Spl	66	Bx 28x 4	Bx	Ol Spr	No	ST	Wl	Fab	8.25
Amer. Airp. & Eng. KR-135	415	27′ 0″	21′ 4″	8′ 6″	175.7	16.9	4.4	5.5	12.9	9.9	Sp	Sol	Sp	G	Fab	Spl	61	Kh 24x 4	Bx	Ol Spr	No	ST	Wl	Fab	1.16
American Eagle 330	119	37′ 0″	24′ 0″	8′ 0″	212	....	....	....	....	....	W	Ro	.....	.....	Fab	Spl	64	26x 4	....	Ol	....	ST	Wl	Fab	....
American Eagle 251	282	31′ 0″	23′ 3″	8′ 4″	300	....	....	....	....	....	W	Ro	W	.....	Fab	Spl	72	30x 5	....	Old	No	ST	Wl	Fab	....
American Eagle 201	293	31′ 1″	22′ 11″	8′ 5″	253	....	....	....	....	....	W	Ro	W	.....	Fab	Spl	65	Aw	....	Ol	No	ST	Wl	Fab	....
American Eagle "Eaglet"	380	34′ 4″	21′ 6″	6′ 10″	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Arrow Aircraft	115	25′ 10″	19′ 3″	7′ 5″	183	8.75	2.9	5.8	13.0	10.4	W	G	W	G	Fab	Spl	78	Wi 26x 4	....	Cs	No	ST	Wl	Fab	3.0
Brunner-Winkle Bird	101, 239	34′ 0″	23′ 0″	8′ 0″	266	.....	.....	.....	.....	.....	W	.....	W	.....	Fab	Spl	.....	.....	No	.....	.....	ST	Wl	Fab	.....
Buhl CA-3-D	163	36′ 0″	28′ 0″	8′ 0″	240	61.0	4.7	8.1	13.6	18.0	Sp	Box	Sp	.....	Fab	Spl	....	Bx 30x 5	Yes	Ol	Yes	ST	Wl	Fab	14.0
Buhl "Bull Pup"	405	30′ 0″	19′ 0″	6′ 6″	109.4	12.6	3.3	6.0	10.4	8.0	Sp	Sol	W	.....	Fab	Spl	67	18x 3	....	Sc	....	D	Rv	D	3.5
Curtiss-Wright Robin	68, 143, 220	41′ 0″	25′ 10″	8 0″	224	22.3	5.4	9.7	25.2	16.8	W	G	Ad	Sd	Fab	Spl	96	Bx 28x 4	Bx	Ol	No	ST	Wl	Fab	12.5
Curtiss-Wright Moth	197	30′ 0″	24′ 11″	8′ 9″	215	22.2	2.7	9.5	13.3	12.9	Sp	G	Ad	Sd	Fab	Spl	60	24x 4	....	R	No	ST	Wl	Fab	2.0
Curtiss-Wright Sport Trainer	401, 406, 407, 411	28′ 10″	20′ 7″	8′ 10″	206	17.6	5.0	7.65	15.4	12.7	Sp	Sol	Sp	Trs	Fab	Spl	76	Aw 65x 10	St	Hyd	St	ST	Wl	Fab	2.0
Curtiss-Wright Junior	397	39′ 6″	21′ 3″	7′ 4″	176	18.8	5.1	8.8	13.5	14.7	Sp	Sol	Sp	Trs	Fab	Cant	53	Aw 16x 7	Op	S. Spr	Op	ST	Wl	Fab	....
Davis D-1	256, 272, 317	30′ 3″	21′ 6″	7′ 0″	145	.....	.....	.....	.....	.....	Sp	Ro-Lmd	D	Sd	Fab	Spl	78	Kh	....	Sc	....	ST	Wl	Fab	.....
Detroit Aircraft-Parks P-1	179	30′ 1″	24′ 1″	9′ 4″	263	27.0	4.0	7.2	27.4	16.9	Sp	Ro	Sp,Ply	F	Fab	Spl	99	Wi 28x 4	....	Rus	No	ST	Wl	Fab	2.0
Detroit Aircraft-Ryan P-2	200, 276	29′ 10″	23′ 6″	9′ 3″	251	34.0	4.0	7.2	27.4	16.9	Sp	Ro	Sp,Ply	G	Fab	Spl	65	Bx 30x 5	Bx	Rus	No	ST	Wl	Fab	2.5
Driggs Skylark	303	28′ 3″	21′ 6″	8′ 0″	186	19.4	3.8	7.3	13.8	10.9	Sp	Sol	D	Sd	Fab	Spl	72	Wi 6.50x 10	Yes	Old, R	No	St	Wl	Fab	....
Fleet	122, 131	28′ 0″	21′ 0″	7′ 10″	182	11.8	1.6	8.1	13.1	4.8	Sp	Lmd	D	Rv	Fab	Spl	64	Wi 26x 5	Dp	Ol	No	ST	Wl	Fab	....
Granville GeeBee "E"-"D"	398, 404	25′ 0″	17′ 3″	8′ 0″	89.7	10.3	4.8	6.0	10.6	8.4	Sp	Sol	Ply	G	Fab	W. B.	70	Go 6.50x 10	Ap	Ol. Spr	....	ST	Wl	Fab	2.0
Great Lakes 2-T	228	26′ 8″	20′ 4″	7′ 11″	171	16.6	3.5	5.7	13.5	9.5	Sp	I	D	Sd	Fab	Spl	70	Wi 24x 4	Bx	Ol	No	ST	Wl	Fab	....
Inland Sport	259, 315, 343	30′ 0″	19′ 11″	7′ 2″	131.5	12.5	5.8	6.1	13.0	8.9	Sp	Ro	Sp	Trs	Fab	Spl	86	Acp	Op	Old	....	ST	Wl	Fab	6.0
Laird LC-R	176	34′ 0″	23′ 9″	9′ 3″	202	....	13.0	....	26.0	....	W	Sol	Sp	G	Fab	Spl	....	Bx	Bx	R, Cd	No	DT	Rv	Fab	....
Laird LC-RJ	152	28′ 0″	22′ 9″	9′ 3″	202	....	13.0	....	26.0	....	W	Sol	Sp	G	Fab	Spl	....	Bx	Bx	R, Cd	No	DT	Rv	Fab	....
Laird Whirlwind LC-B	353, 86	34′ 0″	23′ 9″	9′ 3″	295	.....	.....	13.0	.....	36.0	Sp	Sol	Sp,Ply	G	Fab	Spl	....	Bx 30x 5	Yes	Sc	No	D	.....	Fab	40.0
Laird Speedwing	377	28′ 0″	22′ 7″	9′ 0″	202	.....	.....	13.0	.....	26.0	Sp	Sol	Sp,Ply	G	Fab	Spl	....	Bx 30x 5	Yes	Sc	No	D	.....	Fab	38.0
Lincoln PT	181, 279, 284, 344	32′ 3″	25′ 3″	9′ 3″	246	30.5	5.2	7.5	17.5	16.0	Sp	Sol	W	.....	Fab	Spl	76	26x 4	....	Sc	....	ST	Wl	Fab	2.0
Lincoln AP	372, 373	37′ 0″	26′ 0″	8′ 4″	188	18.6	6.8	7.9	22.0	15.0	Sp	Ro, I	W	.....	Fab	Spl	104	7.5x 10	Apc	Apc	....	ST	Wl	Fab	9.0
Mercury Chic	235	35′ 8″	23′ 0″	8′ 7″	192	34.0	6.9	5.8	....	18.6	ST	Wl	ST	Wl	Fab	Spl	77.5	28x 4	No	Sc R	No	ST	W	Fab	....
Mono Corp. Monoprep	218	32′ 0″	21′ 0″	.....	.....	.....	.....	.....	.....	.....	W	.....	W	.....	Fab	Spl	.....	.....	.....	Ol Cs	.....	ST	Wl	Fab	.....
Mono Corp. Monocoup	327	32′ 0″	20′ 4″	6′ 11″	132.3	15.5	4.1	5.8	10.6	9.2	Sp	Sol	Sp	G	Fab	Spl	63	6.5x 10	Acp	Old	Yes	ST	Wl	Fab	4.5
Mohawk Pinto	263, 297	34′ 11″	24′ 2″	7′ 7″	145	11.9	5.3	6.7	15.5	11.1	W	Box	Ply	G	Fab	Spl	101	Bx 24x 4	Bx	Aer	No	ST	Wl	Fab	9.3
New Standard D-26	225	45′ 0″	26′ 10″	10′ 2″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96	.....	....	Old	Yes	D	Rv	Fab	3.4
New Standard D-29	216, 324	30′ 0″	24′ 5″	9′ 2″	245	10.7	3.6	9.9	19.5	13.5	Sp	Sol	Ply	G	Fab	Spl	78	Kh 26x 4	....	Old	....	D	Rv	Fab	2.5
Nicholas-Beasley NB-4	385, 386	32′ 9″	23′ 6″	6′ 11″	159	19.5	4.6	6.3	15.9	10.9	D	Sd	D	Sd	Fab	Spl	72	Wi 24x 3	No	Ol	No	ST	Wl	Fab	....
Pitcairn P-7	196	33′ 0″	23′ 9″	9′ 6″	222	20.8	4.2	6.2	15.4	12.5	Sp	Ro	Sp	.....	Fab	Spl	78	Bx 30x 5	Bx	Cr	....	ST	Wl	Fab	42.0
Rearwin 2000	232, 314	35′ 0″	25′ 0″	9′ 11″	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Bx 28x 4	Bx	R, Ol	.....	.....	.....	.....	.....
Simplex Red Arrow	43, 238	34′ 2″	22′ 0″	6′ 11″	150	18.0	3.6	5.5	9.4	15.1	W	Box	Sp	G	Fab	Spl	.....	26x 4	Op	Old, Sc	No	ST	Wl	Fab	....
Sioux Coupe 90	331	30′ 0″	23′ 2″	7′ 0″	163	.....	.....	.....	.....	.....	Sp	Box	Sp	G	Fab	Spl	72	Aw	Yes	.....	No	ST	Wl	Fab	9.0
Spartan C-3	195, 286	32′ 0″	23′ 3″	8′ 10″	266	25.0	8.1	7.8	23.6	18.0	Sp	I	Sp,Ply	G, Trs	Fab	Spl	83	Bx 30x 5	Bx	Old	Op	ST	Wl	Fab	5.6
Star Cavalier	255, 321	31′ 6″	20′ 1″	6′ 8″	139	17.9	4.8	7.3	14.9	9.9	Sp	Ro, I	Sp	G	Fab	Spl	61	Aw 22x 10	....	Cs	....	ST	Wl	Fab	....
Swallow TP	105, 186, 253	30′ 11″	23′ 9″	8′ 10″	268	28.0	3.6	7.8	14.0	16.5	W	G	W	G	Fab	Str, Al	72	26x 4	....	Sc	....	ST	Wl	Fab	....
Swallow F	125	.....	.....	.....	272	28.0	3.6	8.5	17.5	18.5	W	G	W	G	Fab	Spl	72	30x 5	Bx	Sc	....	ST	Wl	Fab	....
States SE-5F	349	32′ 0″	23′ 0″	8′ 0″	144.4	25.3	8.0	11.5	19.8	12.1	Sp	Sol	W	Trs	Fab	Spl	100	Aw	....	Ol	No	ST	Wl	Fab	....
United Boeing 100	133	30′ 0″	20′ 8″	9′ 7″	228	13.8	1.8	8.2	19.9	13.4	Sp	Box	Sp	G	Fab	Str	75	Bx 30x 5	Bx	Ol	No	S,D	Wl,Rv	D,Fab	4.0
United Aircraft-Stearman C	251	35′ 0″	24′ 11″	9′ 8″	288	22.0	4.6	9.6	25.0	14.6	Sp	Sol, I	Sp	Trs	Fab	Spl	90	Bx 8.50x 10	Bx	Ol, R	No	ST	Wl	Fab	10.0
United Aircraft-Stearman 4	292, 304, 305	38′ 0″	26′ 11″	10′ 2″	307	23.1	6.8	12.5	27.7	15.0	Sp	Sol	Sp	Trs	Fab	Spl	96	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	16.0
United Aircraft-Stearman 6	365, 371	32′ 0″	24′ 3″	9′ 6″	272	26.6	4.4	7.6	19.1	14.5	Sp	Sol	Sp	Trs	Fab	Spl	85	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	3.5
Verville Sport Trainer	323	31′ 0″	24′ 3″	8′ 9″	242	27.6	3.1	9.3	16.6	13.3	Sp	Sql	W	G	Fab	Spl	96	.....	Bx	Old	Yes	ST	Wl	Fab	5.0
Viking Kittyhawk	134, 166, 392	28′ 0″	22′ 6″	8′ 8″	233	22.3	5.7	6.4	24.0	12.8	Sp	Ro	W	G	Fab	Spl	86	Kh 26x 4	Op	Ol	No	ST	Wl	Fab	3.0
Waco F	311, 313, 345, 416	29′ 6″	21′ 4″	8′ 9″	241	22.0	4.5	7.0	12.0	15.5	Sp	Sol	Sp,Ply	G	Fab	Spl	76	6.5x 10	Acp	Ol	Yes	ST	Wl	Fab	....
Waco Taperwing	257	30′ 3″	22′ 7″	9′ 0″	227	....	4.9	7.8	16.1	14.7	W	Sol	W	Trs	Fab	Spl	78	30x 5	Bx	Hyd	....	ST	Wl	Fab	....
Waco Straightwing	168, 240, 333, 337, 339	30′ 7″	23′ 1″	9′ 0″	288	28.7	4.9	7.8	19.5	16.5	Sp	Sol	Sp,Ply	G	Fab	Spl	78	30x 5	Bx	Ol	No	ST	Wl	Fab	....
CARGO PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Curtiss-Wright Carrier Pigeon	237	47′ 6″	34′ 6″	.. ..	.....	.....	.....	.....	.....	.....	ST	Wl	D	.....	.....	Spl	.....	.....	Yes	Ol	.....	.....	.....	MoMe	.....
Detroit-Lockheed Sirius	300, 378	42′ 10″	27′ 6″	9′ 2″	250	25.0	11.0	13.0	39.0	23.5	Sp	Box	Sp	G	Ply	Spl	144	Bx 32x 6	Bx	Ol	No	W	Mo	Ply	50.0
New Standard D-27	226	45′ 0″	26′ 10″	10′ 2″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96	Sa	Sa	Acp	Yes	D	Rv	Fab	64.0
Pitcairn Mailwing	364	35′ 0″	24′ 9″	9′ 9″	278	26.5	6.3	7.9	16.5	16.3	Sp	.....	Sp	.....	Fab	Spl	....	Bx 32x 6	Bx	.....	.....	ST	Wl	Fab	.....
United-Stearman Speedmail	322, 325, 326	38′ 0″	26′ 11″	10′ 2″	284	23.1	6.8	11.2	27.2	16.8	Sp	Sol	Sp	Trs	Fab	Spl	96	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab	45.0

Pitcairn Mailwing	364	35′ 0″	24′ 9″		9′ 9″	278	26.5	6.3	7.9	16.5	16.3	Sp		Sp		Fab	Spl		Bx 32x 6	Bx			ST	Wl	Fab		64.0
United-Stearman Speedmail	322, 325, 326	38′ 0″	26′11″	10′ 2″		284	23.1	6.8	11.2	27.2	16.8	Sp	Sol	Sp	Trs	Fab	Spl	96	Bx 30x 5	Bx	Aer	Yes	ST	Wl	Fab		45.0

Table 2: American landplane specifications

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

CONTINUED FROM PAGE 428

SINGLE-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS

Manufacturer and Designation	A. T. C. Nos.	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Framework			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabiliser	Elevators	Material	How Fabricated	Material	How Fabricated	Covering Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Volume Baggage Compartment, Cu.Ft.
American A & E Co.-Pilgrim 100	390	57′ 0″	37′11″	11′ 6″	361.2	46.8	8.6	18.1	38.9	36.8	ST	Wl	D	Rv	Fab	Spl	144	Bx 36x 8	Bx	Ol, Spr	Yes	ST	Wl	Fab	69
Amer. A & E Co.-Pilgrim 71-71A	89, 289	50′ 0″	32′11″	10′ 0″	275.6	34.0	4.0	12.0	30.4	24.6	Sp	Box	Sp	Trs	Fab	Spl	89	Bx 32x 6	Bx	Ol, Spr	....	ST	Wl	Fab	13
Amer. A & E Co.-Pilgrim 42	242	45′ 0″	30′10″	9′ 2″	236.4	34.0	4.0	12.0	30.4	24.6	Sp	Box	Sp	Trs	Fab	Spl	99	Bx 32x 5	Bx	Ol, Spr	....	ST	Wl	Fab	37
Amer. A & E Co.-Pilgrim 51-51A	286, 358	44′ 0″	30′10″	9′ 1″	236.4	36.0	5.1	10.2	26.1	18.1	Sp	Box	Sp	Trs	Fab	Spl	90	Bx 30x 5	Bx	Ol	Yes	ST	Wl	Fab	35
Alexander Bullet	318	36′ 0″	26′10″	7′ 9″	208	27.5	3.1	9.7	11.1	7.0	W	Lmd	W	Trs	Fab	Cant	78	Bx 23x 5	Bx	Ol	....	ST	Wl	Fab	4.0
American Eagle C-D	301, 320	41′ 0″	27′ 4″	8′ 1″	233	29.6	6.4	10.2	19.8	18.0	W	Ro	W	Sc	Fab	.....	70	30x 5	....	Old	ST	Wl	Fab	.....	.....
Bellanca, (Pac. Frt. Sky.)	129, 245, 319, 328	46′ 4″	27′10″	8′ 4″	273	....	....	....	....	....	Sp	Sol	Sp	G	Fab	Spl	90	Bx 32x 6	Bx	Old	Yes	ST	Wl	Fab	12.0
Bellanca Airbus	360, 391	65′ 0″	40′ 8″	11′ 7″	652	....	....	....	....	....	W	Sol	Sp	G	Fab	Int	216	Aw37x16	Go	Old	Yes	ST	Wl	Fab	35.0
Buhl CA-8	98, 99	48′ 0″	36′ 0″	10′ 0″	462	30.0	5.8	12.7	24.3	24.7	Sp	Box	Sp	.....	Fab	Spl	....	Bx 36x 8	Bx	Ol	Yes	ST	Wl	Fab	50.0
Buhl CA-6	128	40′ 0″	29′ 8″	8′ 7″	315	27.5	5.0	8.7	18.0	18.7	Sp	Box	Sp	.....	Fab	Spl	....	Bx 32x 6	Bx	Ol	Yes	ST	Wl	Fab	24.0
Cessna DC-6	243, 244	40′ 8″	27′11″	7′ 8″	265	17.8	5.3	9.3	22.2	16.2	Sp	Box	Ply	G	Fab	Spl	102	Bx 30x 5	Bx	Old	Yes	ST	Wl	Fab	18.0
Curtiss-Wright Airplane Co	309	41′ 4″	25′ 1″	8′ 0″	203	22.3	10.7	10.5	25.2	16.8	Sp	I	Ad	Sd	Fab	Spl	101	Bx 30x 5	Bx	Ol	Yes	ST	Wl	Fab	12.5
Curtiss-Wright Airplane Co	352	48′ 6″	31′ 4″	9′ 3″	282	30.4	6.8	13.5	35.1	21.2	Sp	Box	Sp	Trs	Fab	Spl	108	Bx 32x 6	Bx	Ol, Cs	Yes	ST	Wl	Fab	27.8
Detroit-Lockheed Vega	140, 252, 227, 93	41′ 0″	27′ 6″	8′ 2″	250	25.0	12.5	10.2	31.5	16.0	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	W	Mo	Ply	12.0
Detroit-Lockheed Vega DL-1	308	41′ 0″	27′ 6″	8′ 2″	250	25.0	12.5	10.2	31.5	16.0	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	Ad	Rv	Ad	12.0
Detroit-Lockheed Air Express	102	43′ 0″	27′ 6″	9′ 8″	270	25.0	10.6	8.5	39.0	23.5	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	W	Mo	Ply	25.0
Detroit-Lockheed Orion	421	42′10″	27′ 6″	9′ 0″	275	25.0	11.0	13.0	39.0	23.5	Sp	Box	Sp	G	Ply	Ret	139	Ap 11x12	Ap	Ol	Yes	W	Mo	Ply	20.0
Detroit-Ryan Brougham	142, 262	42′ 4″	29′11″	9′10″	250	22.0	6.2	11.1	27.5	17.0	Sp	G	Sp	G	Fab	Spl	120	Bx 30x 5	Bx	Ol	Yes	ST	Wl	Fab	20.0
Detroit-Ryan Foursome	346	42′ 3″	27′10″	9′ 9″	219	20.0	8.9	9.5	27.5	17.0	Sp	G	S	W	Fab	Spl	108	Bx 30x 5	Bx	R	Yes	ST	Wl	Fab	5.0
Consolidated Fleetster	291	45′ 0″	31′ 9″	9′ 2″	313	33.4	13.5	10.6	25.3	17.2	Sp	Box	Sp	Trs	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	D	Rv	D	20.0
Consolidated Fleetster	320, 369	45′ 0″	31′ 9″	10′ 7″	280	33.4	13.5	10.6	25.3	17.2	Sp	Box	Sp	Trs	Ply	Spl	96	Bx 32x 6	Bx	Ol	Yes	D	Rv	D	20.0
Fokker X Universal	164	47′ 9″	33′ 6″	8′ 6″	341	20.0	2.2	11.6	23.9	25.7	Sp	Box	Ply	G	Ply	Spl	120	Sa 32x 6	Sa	Rus	No	ST	Wl	Fab	30 0
Fokker AF-14	234	59′ 5″	43′ 4″	12′ 4″	550	36.0	4.7	13.5	36.8	34.7	Sp	Box	Ply	G	Ply	Spl	162	Bx 36x 8	Bx	Gr, Rus	Yes	ST	Wl	Fab	34.0
Fokker Superuniversal	52	50′ 8″	36′11″	9′ 1″	387	22.8	2.2	11.6	23.9	25.7	Sp	Box	Ply	G	Ply	Spl	124	Sa 32x 6	Sa	Cd, Rus	No	ST	Wl	Fab	30.0
Mono Monocoach	275	39′ 0″	26′ 9″		122	.....	.....	.....	.....	.....	W	.....	W	.....	Fab	Spl	....	.....	Bx	Ol, Cs	No	ST	Wl	Fab	.....
New Standard D-25	224	45′ 0″	26′10″	10′ 7″	350	26.0	6.5	12.8	33.2	19.7	Sp	I	Ply	G	Fab	Spl	96	Sa	Sa	Old	Yes	D	Rv	Fab	4.0
Northrop Alpha	381	41′10″	28′ 4″	9′ 0″	275	2.0	8.4	7.9	27.0	14.7	Ad	Rv	Ad	Rv	Ad	Spl	102	Bx 32x 6	Bx	Ol, Gr	Yes	Ad	Mo	Ad	12.0
Spartan C-4	310, 383, 394	50′ 0″	32′ 7″	9′ 0″	299	36.5	7.0	14.6	13.5	12.9	Sp	I	Ply	G	Fab	Spl	120	Bx 32x 6	Bx	Cs Hyd	Yes	ST	Wl	Fab	9.1
Spartan C-5	389	50′ 0″	32′ 7″	8′11″	299	36.5	7.0	14.6	13.5	12.9	Sp	I	Ply	G	Fab	Spl	122	Aw9.5x12	Ap	Cs Hyd	Yes	ST	Wl	Fab	10.5
Stinson SM-7	329	41′ 8″	31′ 0″	8′ 9″	209	25.4	5.2	11.6	23.3	23.3	Sp	Ro	Sp	G	Fab	Spl	115	Wi 30x 5	Kh	Own	Yes	ST	Wl	Fab	7.0
United-Boeing 40-B	183	44′ 2″	33′ 4″	11′ 9″	545	36.0	8.4	15.9	43.2	28.3	Sp	Ro	Sp	Web	Fab	Str	80	Bx 36x 8	Bx	Ol	No	ST	Wl	D,Fab	25.0
United-Boeing 221	366	59′ 1″	40′ 9″	.....	525	42.0	9.4	18.4	52.8	37.2	D	Bo, Rv	D	Rv	D	Spl	101	Bx 36x 8	Bx	Ol	Yes	D,S	Rv,Wl	D	100.0
United-Stearman LT-1	187	49′ 0″	32′ 6″	12′ 6″	460	29.6	9.2	14.1	30.8	28.0	Sp	Box	Sp	Trs	Fab	Spl	96	Bx 36x 8	Bx	Aer	Yes	ST	Wl	Fab	40.0
Waco-QDC	412	33′ 3″	23′ 2″	8′ 5″	245	22.3	6.1	8.6	14.1	17.1	W	.....	W	.....	Fab	Spl	72	7.5x10	....	Ol	Yes	ST	Wl	Fab	5.0

MULTI-ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS

Curtiss Aero. & Motor Co.Condor	193	91′ 8″	57′ 1″	16′ 6″	1,512	241	....	53.0	....	47.6	D	Rv	D	Rv	Fab	Tred	....	.....	Yes	Ol	Yes	D	Rv	Ply	.....
Curtiss-Wright Kingbird	347, 348	54′ 6″	34′10″	10′ 0″	357.2	47.8	10.3	27.6	65.1	37.3	S	Wl	D	Rv	Fab	Spl	163	Bx 36x 8	Bx	Ol	Yes	DT	Rv	Fab	15.0
Curtiss-Keystone Patrician	260	86′ 6″	61′ 7″	13′ 4″	930	64.0	27.8	31.9	62.8	44.6	W	Box	W	G	Fab	Spl	234	44x10	Yes	Ol	Yes	ST	.....	Fab	75.0
Fokker AF-10A	96	79′ 3″	50′ 7″	12′ 9″	854	60.0	8.0	20.5	41.0	44.0	W	Box	Ply	G	Ply	Tred	186	Sa 44x10	Sa	Cd	Yes	ST	Wl	Fab	62.0
Fokker AF-32	281	99′ 0″	70′ 2″	16′ 2″	1,330	91.8	30.4	56.0	90.0	77.4	Sp	Box	Ply...	G	Ply	Tred	240	Bx 58x14	Bx	Gr	Yes	ST	Wl	Fab	120.0
Ford 4-AT-E	132	74′ 0″	49′10″	11′ 9″	785	52.0	12.7	24.2	53.5	39.2	D	Rv	.....	.....	Ad	Tred	201	Wi 36x 8	Hyd	Aer	Yes	D	Rv	Ad	27.0
Ford 5	409	77′10″	50′ 3″	12′ 0″	835	52.0	12.7	24.2	81.7	46.8	D	Rv	.....	.....	Ad	Tred	223	Bx 44x10	Hyd	Aer	Yes	D	Rv	Ad	119.0
Ford 7-A	246	77′10″	50′ 3″	12′ 8″	835	52.0	12.7	24.3	65.3	46.8	D	Rv	.....	.....	Ad	Tred	223	Bx 44x10	Hyd	Aer	Yes	D	Rv	Ad	27.0
Ogden Osprey	332	50′ 0″	34′ 6″	9′ 3″	286	26.0	9.2	9.5	24.8	17.5	Sp	Box	Sp	Trs	Fab	Spl	168	Bx 32x 6	Bx	Old	Yes	ST	Wl	Fab	12.0
Stinson Tri-motor Sm-6000	335	60′ 0″	42′10″	12′ 0″	490	42.0	10.0	16.0	42.2	23.0	ST	Wl	D	Rv	Fab	Spl	204	Bx 36x 8	Bx	Aer	Yes	ST	Wl	Fab	.....

See page 432 for key

Table 3: Amphibions and flying boats

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

CONTINUED FROM PAGE 429

Manufacturer and Designation	A. T. C. Nos	GENERAL			AREAS (Sq.Ft.)						WINGS					LANDING GEAR						FUSELAGE OR HULL			
											Spars		Ribs									Frame-work			
		Span	Length Overall	Height Overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How Fabricated	Material	How Fabricated	overall Material	Type	Tread, In.	Wheel Type and Size	Brakes	Shock Unit Lg. and Tail	Tail Wheel	Material	How Fabricated	Covering Material	Volume Baggage Compartment, Cu. Ft.
American Aeronautical S-56	287, 336	34′ 1″	25′ 2″	10′ 1″	262	24.2	9.0	8.0	17.5	15.5	Sp	Box	Sp	G	Fab	.....	64	Wi 20x 4	No	Sc	No	W	Bo	Ply	.....
Amphibions, Inc. Ireland	153, 248	40′ 0″	31′ 0″	12′ 2″	323	53.2	15.6	18.2	19.1	25.8	Sp	Ro	D	Sd	Fab	Spl	94	Bx 32x 6	No	Ol	No	ST	Wl	Ad	.....
Amphibions, Inc. Privateer	370	38′ 0″	28′ 0″	9′ 6″	198	26.5	11.0	10.9	25.1	16.6	Sp	I	S	Wl	Fab	Cant	62	Kh21x 6	No	Aw	Yes	Sp	Bo	Ad	3.0
Consolidated Commodor	258	100′0″	61′ 6″	15′ 8″	1,000	110	23.7	40.2	81.0	54.5	D	Rv	D	Rv	Fab	.....						D	Rv	D	216.0
C.W.-Keystone Air Yacht	90	46′ 8″	34′ 9″	13′ 2″	500	60.6	27.4	18.7	37.0	27.6	Sp	Sol	D	Sd	Fab	Spl	94	36x 8	No	Aer	No	W	Bo	D	20.0
C.W.-Keystone Commuter	219	40′ 0″	32′ 1″	13′ 6″	437	30.0	28.0	16.3	40.0	22.0	Sp	Sol	D	Sd	Fab	Spl	93	30x 5	No	Ol	No	W	Bo	D	3.0
Detroit-Eastmen E-2	288, 338	36′ 0″	26′ 3″	9′ 4″	207	36.0	6.1	9.5	27.4	16.0	Sp	Box	Sp	G	Fab	Spl	55	20x 6	No	Ol	No	W	Bo	Ad	.....
Douglas Dolphin	422	60′ 0″	44′ 4″	14′ 5″	562	40.0	33.4	16.1	45.8	31.2	Sp	Box	Sp	Trs	Ply	Ret	173	Bx 36x 8	Bx	Gr	Yes	D	Mo	D	78.0
Fokker AF-11A	222	59′ 0″	45′10″	14′ 5″	550	36.0	28.0	18.0	39.0	36.0	Sp	Box	Ply	G	Ply	Spl	122	Bx 36x 8	Bx	Rus	No	D	Rv	D	30.0
United-Boeing 204	157	39′ 8″	32′ 6″	12′ 0″	470	38.4	14.5	17.1	26.0	28.0	Sp	Ro	Sp	Web	Fab	.....						Ply	G. Bo	.....	15.0
United-Sikorsky S-38	126, 356	71′ 8″	40′ 3″	13′10″	720	42.5	15.0	20.0	51.4	35.5	D	Trs	D	Trs	Fab	Hyd	.....	Go	Own	Hyd		W	Sd	Ad	.....
United-Sikorsky S-39	375	52′ 0″	31′11″	11′ 3″	320	30.0	4.8	20.6	29.8	18.5	D	Trs	D	Trs	Fab	Hyd	120	Go	Own	Hyd	Yes	D	Sd	Ad	26.0
United-Sikorsky S-41	418	78′ 9″	45′ 2″	15′ 3″	729	60.0	12.6	27.6	60.3	34.2	D	Trs	D	Trs	Fab	Hyd	135	Go	Own	Hyd	Yes	D	Sd	Ad	.....
Viking V-2	361	42′ 4″	29′ 4″	10′ 4″	359	42.1	4.0	13.0	32.2	27.3	Sp	Box	Ply	G	Fab	.....						W	G	Ply	3.0

A —Amphibion
Ad —Alclad
Aer —Aerol
Al —Axle
Amer—American
Ans —Ansani
Apl —Applied
Aw —Air Wheels
Ax —Axelson
B —Biplane
Bak —Bakelite
Be —Beam
Bo —Bolted
Box —Box spar
Br —Brownback
Bx —Bendix
C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Co —Comet
Com —Compression
Con —Continental
Cq —Conqueror
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone
D —Duralumin
Dep —Deperdussin
Du —Dual
Ex —Extra
F —Flying boat
Fab —Fabric
Fl —Flottorp
G —Glued
Ge —Genet
Go —Goodyear
Gr —Gruss
Gt —Gov't test
Gy —Gipsy
H —Hamilton
He —Henderson
His —Hispano
Ht —Heat treated
Hw —Hess Warrior
Hyd —Hydraulic
Iz —Hartzell
I —"I" section
In —Internal
Ir —Irwin
K —Kinner
Kh —Kelsey-Hayes
L —Landplane
La-l —Ace
Lam —Lambert
Lb —LeBlond
Li —Liberty
Lk —Lockheed
Lmd —Laminated
Lr —LeRhone
Ly —Lycoming
M —Monoplane
Me —Metal
Mo —Monocoque
Ms —Mfr's statement
N —New
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional
OX-5—Curtiss
P —Paragon
Pe —Pedal
Pdd —Packard Diesel
Pk —P-K screws
Ply —Plywood
Pn —Pneumatic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr.
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Re —Reed
Ro —Routed
Rus —Rusco
Rv —Riveted
S —Steel
Sa —Sausedde
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
Sk —Stick
Sol —Solid
Sp —Spruce
Spl —Split
St —Standard
Str —Straight
Su —Supreme
Sy —Story
Sz —Szekely
T —Tubing
Tr —Trombone
Tred —Treadle
Trs —Truss
W —Wood
Wa —Walter
War —Warner
Wat —Warren Truss
We —Westinghouse
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Wt —Wind Tunnel
Ww —New Whirlwind
Y —Yankee
Z —Seaplane
* —Without engine

Table 4: American engine specifications

AVIATION does not assume responsibility for the figures given

Manufacturer or Agent	Engine	Cooling System	Cylinder Arrangement	No. of Cylinders	Strokes per Cycle	Propeller Drive	Rated Hp. and R.P.M. at Sea Level	Maximum Hp. and R.P.M. at Sea Level	Weight Dry Without Hub or Starter	Weight per Rated Hp.	Bore and Stroke (in.)	Compression Ratio	B.M.E.P.	Displacement (cu.in.)	Frontal Area (sq.ft.)	Diameter of Mounting Ring or Distance Between Bearers (in.)	Height or Overall Diameter (in.)	Length Without Starter (in.)	Guaranteed Fuel Consumption at Rated Hp. Lb.Hp.Hr.	Oil Consumption Lb. Hp. Hr.	Valve Mechanism	Cylinder Construction (See Footnote)	No. Intake Valves per Cylinder	Make Spark Plugs Supplied with Engine	No. Exhaust Valves per Cylinder	Type of Ignition	Make Ignition	No. Carburetors	Make Carburetors	Make Starter	Are Exhaust Manifolds Provided	Shipping Weight Crated	Dept. of Commerce License Number	Price at Factory
Aeronautical Corp. of America	Aeronca E113	A	Opp	2	4	D	36–2400	38–2520	100	2.75	4¼x4	5.1	105	113	....	....	24	24	.57	.017	prr	Aa, S	1	RB	1	1M	RB	1	Wf, Z	....	No	160	71	750
Aeronautical Corp. of America	Aeronca E-107A	A	Opp	2	4	D	30–2500	32–2800	100	3.3	4¼x4	3.8	90	107	....	....	24	24	.57	.017	Lh	Aa, NI	1	RB	1	1M	RB	1	Wf, Z	....	No	160	....	.....
Allison Engineering Co	V1410	A	IV-45°	12	4	D	410–1800	430–1900	1000	2.44	4⅝x7	5.3	128	1410	....	17	46¾	78½	.55	.03	ohc	Al, S	1	BG	1	2B	De	1	Sg	Ec	....	....	Y	.....
Allison Engineering Co	V1650	W	IV-45°	12	4	D	420–1700	450–1800	885	2.10	5 x7	5.4	122	1650	....	17	46 7/16	74½	.53	.025	ohc	S	1	BG	1	2B	De	2	Sg	Ec	....	....	Y	.....
A. C. E. Corp	Cirrus	A	L	4	4	D	90–2100	95–2100	270	3.0	4⅝x5⅛	5.4	122	310	....	21 17/64	36⅜	38½	.55	.021	prr	Al, S	1	AC	1	2M	Se	1	Sg	Op	No	530	30	795
A. C. E. Corp	Cirrus Hi-Drive	A	IL	4	4	D	95–2100	95–2100	272	3.0	4⅝x5⅛	5.4	122	304	....	20½	27 9/32	43 13/16	.55	.02	prr	Al, S	1	RC	1	2M	Se	1	Sg	Op	No	530	60	895
Chevolair Motors, Inc	D-4	A	L	4	4	D	90–2000	115–2300	345	3.8	4⅝x5¼	5.5	120	352	1.8	....	28	39	.52	.03	ohc	.....	2	.....	2	2M	RB	2	Sg	Op	Yes	...	35	1,850
Chevolair Motors, Inc	D-6	A	L	6	4	D	165–2175	175–2350	435	2.61	4⅝x5¼	5.5	118	529	1.8	....	28	58	.55	.030	ohc	Al, S	2	Op	2	2M	RB	2	Sg	Op	Yes	....	56	2,500
Comet Engine Corp	Comet	A	Rad	7	4	D	165–1900	....	400	2.42	4½x5½	5.2	112	612	....	17½	48½	35⅝	.53	.015	prr	Al, S	1	AC	1	2M	Se	1	Sg	Bs	....	775	47	2,700
Continental Aircraft Engine Co	A-70-2	A	Rad	7	4	D	165–2000	183–2200	415	2.5	4⅝x4⅝	5.4	122	544	6.9	20	42¾	32⅝	.55	.025	prr	Al, S	1	AC	1	2M	Se	1	Ho	Op	Yes	870	32	2,600
Continental Aircraft Engine Co	A-40	A	Opp	4	4	D	37–2550	39–2800	136	3.7	3½x3¾	5.2	....	115	....	....	16 5/16	26⅜	.52	.025	Lh	Al, NI	1	AC	1	1M	Se	1	Z	....	No	240	72	540
Dayton Airplane Engine Co	Bear	A	L	4	4	D	110–1500	120–1800	375	3.4	4½x7	5.3	118	445	....	16	38⅝	54 37/32	.525	.0125	ohc	Al, NI	1	BG	1	2M	RB	1	Z	No	No	550	11	1,450
Irwin Aircraft Co	Irwin 79	A	Rad	4	2	D	20–1700	25–2200	57	3.00	2⅞x2¾	4.8	105	79	....	10	23	18	.50	.0311	Au	Aa, Aa, S	1	RB	1	1M	RB	2	Wf	....	No	100	N	550
Jacobs Aircraft Engine Co	Jacobs LA-1	A	Rad	7	4	D	165–2125	....	390	2.36	4.5x4.75	4.8	112	528	....	14¾	44	33	.53	.017	prr	Al, S	1	Ch	1	2M	Se	1	Sg	Op	Yes	660	31	.....
Kinner Airplane & Motor Corp	K-5	A	Rad	5	4	D	100–1810	105–1900	280	2.80	4.25x5.25	5.0	118	372	....	14	44⅝	32 1/16	.60	.010	prr	Al, S	1	BG	1	2M	Se	1	SgHy	Op	Yes	580	3	1,800
Kinner Airplane & Motor Corp	B-5	A	Rad	5	4	D	125–1925	127–1950	295	2.4	4⅝x5¼	5.2	117	441	....	14	45⅝	32 1/16	.60	.010	prr	Al, S	1	BG	1	2M	Se	1	SgHy	Op	Yes	595	51	2,270
Kinner Airplane & Motor Corp	C-5	A	Rad	5	4	D	210–1900	245–2200	420	2.0	5⅝x5¾	5.2	122	715	....	19¼	50	34 13/16	.60	.015	prr	Al, S	1	BG	1	2M	Se	1	Sg	Op	Yes	950	62	3,000
Kimball Aircraft Corp	Beetle, Model K	A	Rad	7	4	D	135–1850	150–2000	370	2.74	4½x5½	5.2	100	585	....	17	45	37¾	.54	.015	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	550	34	2,300
Lambert Aircraft Engine Corp	Velie M-5	A	Rad	5	4	D	165–2000	....	370	2.46	5 x5½	5.0	....	540	....	19¼	45	28 29/32	.55	.035	prr	Al, S	1	Ch	1	2M	Se	1	Z	Ec	Yes	420	4	1,050
Lambert Aircraft Engine Corp	R-266	A	Rad	5	4	D	90–2375	....	214	2.37	4¼x3¾	5.5	113	....	....	13¾	33	30⅜	.58	....	prr	Al, NI	1	Ch	1	2M	Se	1	Sg	Ec	Yes	400	38	1,460
LeBlond Aircraft Eng. Corp	5-DE	A	Rad	5	4	D	70–1950	75–2075	235	3.35	4⅛x3¾	5.4	116	250	....	....	33¼	22¼	.58	.015	prr	C	1	.....	1	DM	RB	1	Hy	Ec	No	460	48	1,230
LeBlond Aircraft Eng. Corp	5-DF	A	Rad	5	4	D	85–2125	90–2250	219	2.57	4¼x3¾	5.4	119	266	....	....	33¼	22¼	.52	.015	prr	Al, S	1	.....	1	DM	RB	1	Hy	Ec	No	450	46	1,400
LeBlond Aircraft Eng. Corp	7-DF	A	Rad	7	4	D	110–2150	119–2275	275	2.50	4¼x3¾	5.4	113	372	....	....	33¼	23 1/16	.54	.015	prr	Al, S	1	.....	1	DM	Se	1	Hy	Ec	No	490	52	2,160
Light Mfg. & Foundry Co	Tiger-100	A	Rad.S	6	4	D	100–1900	105–1890	264	2.6	4.13x4.9	4.8	105	397	....	13	37½	29¾	.52	.012	prr	Al, C	1	Ch	1	2M	Op	1	Op	Op	Yes	492	33	1,295
Lycoming Mfg. Co	R-680	A	Rad	9	4	D	210–2000	....	475	2.26	4⅝x4½	5.3	123	680	....	19¼	43¼	32⅝	.55	.025	prr	Al, S	1	BG	1	Sid	Se	1	Sg	Ec	Yes	875	42	.....
Mac Clatchie Mfg. Co	Panther	A	Rad	7	4	D	150–1900	160–2000	458	3.00	4½x5½	5.0	120	612	....	17½	36	36½	.56	.006	Lh	Al, S	1	BG	1	2M	Se	1	Sg	Op	Yes	775	49	.....
Glenn L. Martin Motors Co	D-333	A	IL	4	4	D	120–2100	130–2300	265	2.2	4½x5¼	5.3	136	333	....	11	33⅝	42¼	.50	.010	ohc	Al, S	1	Ch	1	2M	Se	1	Z	Op	No	400	59	.....
Menasco Motors, Inc	Pirate, B-4	A	IL	4	4	D	95–2000	100–2250	280	2.95	4½x5½	5.5	115	326	2.6	11⅜	28	47¾	.54	.006	prr	Al, NI	1	Ch	1	2M	Se	1	Sg	Ec	No	430	65	1,560
Menasco Motors, Inc	Pirate-C-4	A	IL	4	4	D	125–2175	135–2500	275	2.3	4¾x5½	6.5	125	363	2.6	11⅜	28	47¾	.50	.027	prr	Al, NI	1	BG	1	2M	Se	1	Sg	Ec	No	430	....	1,860
Menasco Motors, Inc	Buccaneer-B-6	A	IL	6	4	D	160–1975	180–2500	365	2.2	4½x5½	5.5	130	489	2.6	11⅜	28	59¼	.54	.006	prr	Al, NI	1	Ch	1	2M	RB	1	Sg	Ec	No	570	....	2,475
Michigan Aero Engine Co	Rover	A	IL	4	4	D	75–1975	86–2200	228	3.25	4.125x5	5.1	112.5	267	....	14	31⅞	37½	.55	.018	prr	Al, NI	1	AC	1	2M	Se	1	Sg	N	Yes	370	37	1,200
Packard Motor Car Co	3A-1500	W	v-60°	12	4	D	600–2500	650–2700	760	1.26	5⅜x5½	5.5	140	1530	4.03	15¾	38 15/64	62 11/32	.52	.015	ohc	S	2	BG	2	2M	Se	2	Sg	Ae	No	1275	Y	12,000
Packard Motor Car Co	3A-2500	W	V-60°	12	4	D	800–2000	835–2100	1160	1.45	6⅜x6½	5.7	135	2539	4.8	18¼	36⅛	69¾	.52	.015	ohc	S	2	BG	2	2M	Se	2	Sg	Ae	No	2150	19	15,625
Packard Motor Car Co	DR-980	A	Rad	9	4	D	225–1950	....	510	2.26	4 13/16x6	14.	93	982	....	22	45 11/16	36¾	.46	.04	prr	S	1	.....	1	com	.....	.....	.....	.....	Ec	No	975	43	4,025
Pratt & Whitney Aircraft Co	Wasp C-1	A	Rad	9	4	D	420–2000	450–2100	715	1.7	5¾x5¾	5.2	124	1344	....	23⅜	51 7/16	42 9/16	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1150	14	7,200
Pratt & Whitney Aircraft Co	Wasp CIG	A	Rad	9	4	G⁴	425–2050	....	785	1.8	5¾x5¾	5.2	119	1344	....	23⅜	51 7/16	48	.60	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1300	55	8,200
Pratt & Whitney Aircraft Co	Wasp D	A	Rad	9	4	D	450–2100	500–2200	710	1.6	5¾x5¾	5.2	125	1344	....	23⅜	51½	47	.60	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1150	....	8,200
Pratt & Whitney Aircraft Co	Wasp SC-1	A	Rad	9	4	D	450–2100	....	715	1.6	5¾x5¾	5.2	125	1344	....	23⅜	51½	42 9/16	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1150	58	7,200
Pratt & Whitney Aircraft Co	Hornet A-2	A	Rad	9	4	D	525–1900	....	795	1.5	6⅛x6⅜	5.0	130	1690	....	23⅜	55 7/16	44¼	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1400	15	7,800
Pratt & Whitney Aircraft Co	Hornet A-2G	A	Rad	9	4	G²	500–1900	....	840	1.6	6⅛x6⅜	5.0	123	1690	....	23⅜	55 7/16	50 1/32	.60	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1475	29	8,800
Pratt & Whitney Aircraft Co	Hornet B-1	A	Rad	9	4	D	575–1950	....	840	1.46	6¼x6¾	5.0	125	1860	....	23⅜	56 15/16	44 13/16	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1450	28	7,960
Pratt & Whitney Aircraft Co	Hornet B1G	A	Rad	9	4	G³	550–1950	....	915	1.6	6¼x6¾	5.0	123	1860	....	23⅜	56 15/16	50 27/64	.60	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	1600	....	8,960
Pratt & Whitney Aircraft Co	Wasp, Jr., A	A	Rad	9	4	D	300–2000	....	565	1.8	5¾ 6x5¾ 6	5.0	120	985	....	23⅜	45¾	41 1/16	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	Yes	1025	39	4,860
Pratt & Whitney Aircraft Co	Wasp, Jr., SIA	A	Rad	9	4	D	400–2300	....	565	1.8	5¾ 6x5¾ 6	5.0	140	985	....	23⅜	45¾	41 1/16	.60	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	Yes	1025	66	.....
Szekely Aircraft & Eng. Co	SR-3 Mod. 0	A	Rad	3	4	D	45–1750	46–1750	135	....	4¼x4¾	5.0	106	191	....	10 15/16	36	23	.55	.014	prr	Al, C	1	RB	1	2M	RB	1	Sg	No	....	214	70	.....
Szekely Aircraft & Eng. Co	SR-3 Mod. L	A	Rad	3	4	D	30–1750	36–1750	135	....	4¼x4¾	4.8	90	191	....	0 15/16	30	23	.57	.014	Lh.	Al, C	1	RB	1	2M	RB	1	Sg	No	....	214	53	.....
Warner Aircraft Corp	Scarab, Jr	A	Rad	5	4	D	90–2025	....	230	2.7	4¼x4¼	5.2	....	301	....	17	36¼	29	.55	.020	prr	Al, S	1	AC	1	2M	Se	1	Hy	Op	No	....	54	.....
Warner Aircraft Corp	Scarab	A	Rad	7	4	D	110–1850	120–1925	270	2.45	4¼x4¼	5.2	112	422	....	17	35½	27½	.50	.01	prr	Al, S	1	AC	1	2M	Se	1	Sg	Op	No	....	2	2,485
Wright Aeronautical Corp	Conqueror	W	V-60°	12	4	D G	600–2400	655–2400	840	1.40	5⅛x6¼	6.1	138	1569	....	15¾	37 29/32	64	.53	.025	ohc	Al, Al,S	2	BG	2	1M	Se	2	Sg	Ec	No	1350	6	.....
Wright Aeronautical Corp	Challenger	A	Rad S,	6	4	D	185–2000	191–2000	440	2.40	5⅛x4⅞	5.2	126	603	....	19	48 1/16	42⅝	.55	.025	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	No	865	5	.....
Wright Aeronautical Corp	Whirlwind 165	A	Rad	5	4	D	165–2000	180–2000	410	2.48	5 x5½	5.1	132	540	....	19¼	45	40 1/16	.55	.025	prr	Al, S	1	BG	1	2M	Se	1	Sg	....	Yes	930	23	3,00u
Wright Aeronautical Corp	Whirlwind 240	A	Rad	7	4	D	240–2000	252–2000	490	2.04	5 x5½	5.1	132	756	....	19¼	45	40 5/32	.55	.025	prr	Al, S	1	BG	1	2M	Se	1	Sg	....	Yes	1110	26	3,90u
Wright Aeronautical Corp	Whirlwind 300	A	Rad	9	4	D G	300–2000	325–2000	575	1.88	5 x5½	5.1	132	973	....	19¼	45	40 11/16	.55	.025	prr	Al, S	1	BG	1	2M	Se	1	Sg	....	Yes	1115	21	4,80u
Wright Aeronautical Corp	Whirlwind 400	A	Rad	9	4	D G	400–2300	420–4300	575	1.44	5 x5½	5.1	148	973	....	19¼	45	41 11/16	.55	.035	prr	Al, S	1	AC	1	2M	Se	1	Sg	Ec	No	1115	....	3,90u
Wright Aeronautical Corp	Cyclone 525	A	Rad	9	4	D G	525–2000	552–1900	825	1.57	6 x6⅞	5.1	130	1750	....	23⅜	54 11/16	43 27/32	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	Yes	1625	17	7,00u
Wright Aeronautical Corp	Cyclone 575	A	Rad	9	4	D G	575–2000	605–1900	835	1.45	6⅛x6⅞	5.1	138	1823	....	23⅜	54 11/16	43 27/32	.55	.035	prr	Al, S	1	BG	1	2M	Se	1	Sg	Ec	Yes	1635	61	7,18o
Wright Aeronautical Corp	Gypsy L-320	A	L	4	4	D	90–1950	96–1950	285	3.17	4½x5	5.0	120	318	....	11 11/16	34 3/16	43 7/32	.55	.0 0	prr	Al, C	1	AC	1	2M	Se	1	Sg	Ec	Yes	500	40	1,36u

A— Air cooled
Aa— Aluminum Alloy
Al— Aluminum
B— Battery ignition
RB— Robert Bosch
Bs— Scintilla booster magneto
C— Cast iron

Ch— Champion
Cm—Compression
D— Direct
De— Delco
Du— Duplex
Dx Dixie
DM—Dual Magneto

Ec— Eclipse
G— Geared
G¹— 5:3 epicyclic gear..
G²— 2:1 reduction gear
G³— 3:2 reduction gear
G⁴— 5:4 reduction gear
GE— General Electric

H— Hexagonal
Hd— Heywood
Ho— Holley
Hy— Holley
I— Inverted
L— Cylinders in line
Lh— "L" head

Mo— Monel
M— Magneto
NI— Nickel iron
Op— Optional
Opp—Opposed
O— Own
ohc— Overhead cam

prr— push rods and rocker arms
Rad—Radial
Rad S—Staggered Radial
S.A.E.—S.A.E. mounting
Sc— Scintilla
Sid— Scintilla—Dual Magneto
Sg— Stromberg

So— Solex
Sp— Splitdorf
S— Steel..
U— U.S.L. Electric
W— Water cooled
Wf— Winfield
Z— Zenith

Note: Cylinder Construction: first symbol designates head, second—walls or waterjacket, and third—sleeve, if any

Flying Equipment

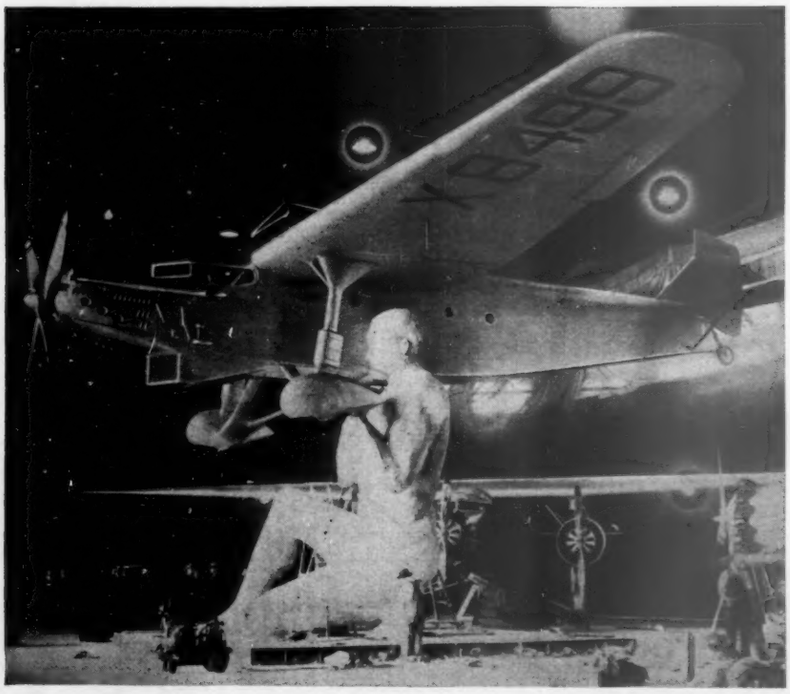
THE FORD FREIGHTER

LONG a protagonist of the tri-engined airplane for passenger transport, the Ford Motor Company of Dearborn, Mich., has placed on the market a single-engined airplane, primarily for freight and express carrying purposes. The new design, although based on recent tri-engined practice is faintly reminiscent of its ancestor, the Liberty-powered Ford of 1924.

Of the seventy-odd airplanes exhibited at the Detroit Aircraft Show last month, the Ford freighter was the only example of an airplane equipped with a liquid-cooled power plant; its single engine being a 650-hp. Hispano-Suiza, 12-cylinder vee type. The radiator, also of vee shape, is mounted on the underside of the fuselage, well back from the nose almost under the pilots' cockpit. Temperature control shutters are provided, and a generous fairing carries the line of the radiator well back into the fuselage. A four-blade wooden propeller of relatively large diameter is fitted to the engine working as a tractor

In the absence of the outboard engine nacelles, the vertical landing gear struts with the usual Ford-type shock absorbers are carried upward into the center section of the wing. Large fairings are provided at the points of intersection. Aside from the changes occasioned by the new power plant arrangement, the Ford freighter is of the same general dimensions and type of construction as the three-engined model. This airplane is said to have a pay load of 3,000 lb. with an empty weight of 6,000 lb. and a gross weight of 11,000 lb.

The S-31



The striking exhibit of the Ford Freighter at the Detroit show, in the making

THE SAVOIA S-31 AMPHIBION

OF the same general type as the well known S-56 Model, but carrying greater horsepower, and embodying certain refinement in design, the American Aeronautical Corporation of Port Washington, N. Y., exhibited the new Model S-31 at the Detroit show. The machine is essentially a hull type flying boat with retractable landing wheels. The wing cellule is of the conventional biplane type and the power plant is carried in a nacelle below, and faired into the center section of the upper wing The propeller is arranged as a tractor. Seats for three persons are provided in a cockpit immediately below the engine nacelle,—two side-by-side in front, both equipped with controls, and the third placed immediately behind the other two without provision for control. Baggage space is provided behind the rear seat.

The power plant is a Kinner V-5 of 125 hp. The general characteristics as given by the manufacturers are as follows:

Span, upper wing	34 ft. 1½ in.
Span, lower wing	28 ft. 10½ in.
Length, over all	25 ft.
Height, wheels down	10 ft. 1½ in.
Wheel tread	64 in.
Wing area	286 sq.ft.
Weight empty	1,492 lb.
Gross weight	2,218 lb.

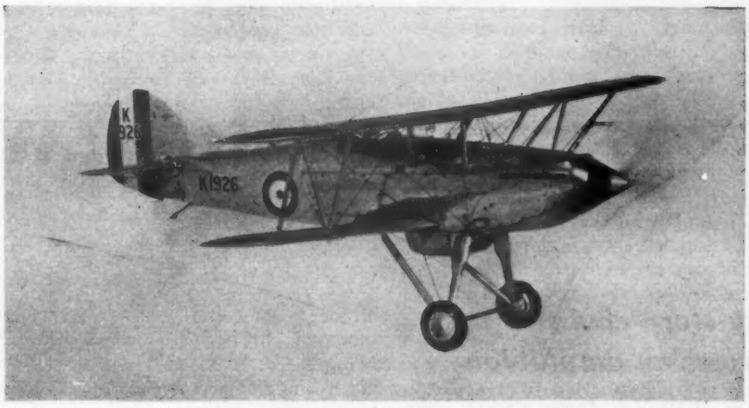
HAWKER FURY BIPLANE

A COMPLETE British Royal Air Force Squadron (No. 43) has just received its full equipment of twelve of the new Hawker Fury single seater pur-

suit planes. This machine is a single-bay biplane built mainly of steel and duralumin. It is fitted with a Rolls-Royce Kestrel S. engine in a detachable mount. The fuselage is of steel and duralumin tubing interconnected by flat plates and tubular rivets; the wings of high tensile steel strip spars with duralumin or wooden ribs. A simple spar shape is used, top and bottom flanges being rolled from one strip, interconnected by a web and assembled by semi-automatic machinery.

Low landing speed and high powers of manoeuvre are features of this machine and R.A.F. pilots are agreed that it is extremely easy to fly. The experimental type attained during the official trials at Martlesham Heath a speed of 214 m.p.h. and the climb to 20,000 ft. was done in nine minutes with full military load.

The Hawker Fury is the latest type of "interceptor fighter" to be used for the Air Defenses of Great Britain.



The British Hawker Fury

The Curtiss-Wright Travel Air

New version of the Robin

THE McCLEARY MONOPLANE

A FOUR-PLACE cabin monoplane of unusual design has been built and test flown by Mr. Earl McCleary of South Gate, Cal. The machine is a pusher type, powered with a 100-hp. upright Cirrus engine mounted above and to the rear of the center section. The closed cabin is suspended below and forward of the wing and the tail surfaces are carried on a narrow triangular fuselage structure, attached to the lower rear portion of the cabin structure. Wings are the semi-cantilever type. The materials and construction are conventional throughout.

The four-place McCleary monoplane

CURTISS-WRIGHT MONOPLANES

A NEW model of the well known Travel Air monoplane has recently been announced by the Curtiss-Wright Corporation. The machine is of the conventional high wing type, powered with a Wright-Whirlwind 300-hp. engine and designed to accommodate six persons. In this model performance has been improved by streamlining and fairing. A cowling of the Townend type encloses the engine, and complete wheel fairings have been provided.

A new version of the well known Robin is now on the market. As in the case of the original design, the new machine is high-wing cabin monoplane of conventional appearance. It is offered for three power plants (1) Curtiss-Wright Challenger, 185 hp.; (2) the Kinner, 210 hp.; and (3) the Wright Whirlwind, 240 hp. Seats are provided for two passengers and two pilots.

APPROVED TYPE CERTIFICATES

DURING the period May 16 to June 13 the Aeronautics Branch of the Department of Commerce issued the following Group I approved type certificates: 415, American Pilgrim 135 (Fairchild 6-390, 120 hp.); 421, Lockheed, Orion Model 9 (P & W Wasp SC 450 hp., 10:1 impeller gears); 422, Douglas Dolphin 1 (two Wright R975E's, 300 hp.); 423, Stinson S (Lycoming R680, 215 hp.); 424, Emsco B7C (Continental A70, Series 2, 165 hp.); 425, Curtiss-Wright, Sedan 15N (Kinner C5, 210 hp.); 426, Curtiss-Wright Sedan 15C (Challenger, 185 hp.).

Aircraft at Work

Drug store chain operates an amphibion

THE Walgreen Drug Stores company has used a Sikorsky S-38 amphibion effectively for several years in advertising and promotional work, and as a part of its personnel program.

A feature of the former has been the giving of a certain number of free rides in connection with the opening of a new branch. In Peoria, Ill., for instance, the company announced in a local paper the offer of 50 free rides to the holders of lucky numbers drawn from coupons presented by persons visiting the store during the business hours of the opening day.

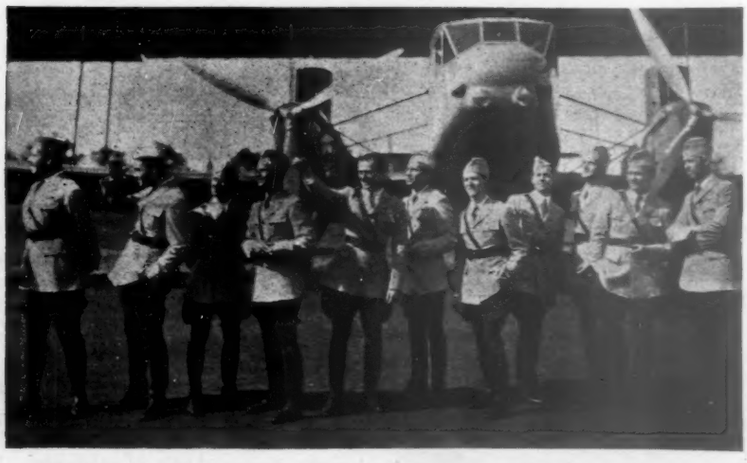
A two-week special publicity campaign was topped off with a so-called "airplane sale" on Friday and Saturday of the last week. The company says: "During this publicity campaign we had an airplane window in each store in the city, showing pictures of ships, including our own. We allow the boys and girls under sixteen years of age to register for rides at any time during the two-week period. Adults may register only during the two days of the sale. Fifty of those registering were chosen by lottery to fly in the plane." Boy Scouts, city officials and other groups have been taken for special rides at various points.

The personnel use of the plane included free rides to employees as a reward for tactful and efficient service. Sales people in all Walgreen branches all over the country have been accommodated through this plan, the plane being flown from land and water ports according to local conditions. When it was visiting the New York area for instance, the plane operated from the North Beach seaplane base, the land plane section not having been in operation at that time. It is used also for the transportation of executives.

Flying musicians travel by plane

THE Musical Aviators, an organization which has been active for more than a year, frequently travels by air to meet engagements. Several members together own a Great Lakes Trainer for personal flying and publicity work for the orchestra, and membership in the organization is premised on ownership of a pilot's license or at least a student permit. Of the eleven men now consituting the band, two have limited commercial, four private and five student ratings.

In traveling by air, the orchestra sometimes uses scheduled airlines and at other times charters a transport. The Trainer is cared for by one member who has the largest investment in it, and the others pay for solo time at the rate of about $3 per hr. The machine has been used to drop circulars advertising the appearance of the band at various points, and occasionally the limited commercial pilots carry passengers for a fee at places visited. The fuselage is decorated with the orchestra's name.



The Musical Aviators in uniform standing before a Curtiss Condor used in one trip to fill an engagement

Prest-O-Lite's planes give valuable service

SO satisfied was the Prest-O-Lite Storage Battery Corporation of Indianapolis with results obtained with its first company-owned plane, that about two months ago it purchased another. The experience of this company is particularly interesting because based on approximately two years continuous use of aircraft in all parts of the country. The first plane, a Ryan Brougham, was flown for about 20 months, during which time the machine was in the air about 900 hr. and covered almost 90,000 mi. About 200 cities were touched. When this report came to hand the company had had its Lockheed slightly over one month; in that time the plane has been flown 40 hr. and had covered about 6,000 mi.

Two of the most important points to be considered in operation of the company-owned plane are expense and ability to keep up schedule. Mr. J. H. McDuffee, vice-president of Prest-O-Lite, says that if the plane was regarded merely as a means of transportation, the company undoubtedly would object to its higher relative cost over the usual modes. However, he says the many advantages of the plane for transportation and the additional advantages of contact which could not be secured in any other way more than balance the difference in cost of transportation.

Operating figures for the Ryan in the period May 15, 1929 to March 6, 1931, are available. The total direct operating expense was $18,341.82, making the operating expense per hour $21.53. These figures include the pilot's salary. The engine consumed 14,281 gal. of gasoline, at the rate of 16.76 gal. per hr., and 377 gal. of oil at the rate of .44 gal. per hr. Thus the plane was operated at an average rate of 6.06 mi. per gal. of gasoline and 229.58 mi. per gal. of oil. The total engine time was 852.12 hr.

Three observations about ground facilities for aircraft may be drawn from Prest-O-Lite's experience. One is that there are several parts of the country over which flying is extremely hazardous because of the insufficient number of emergency landing fields.

Another is that airports as a rule are well manned and, with very few exceptions, all cities of any consequence have adequate ground facilities. A third is that a little closer attention should be given to taxi service between airports and the cities they serve. Distances combined with inferior transportation service create annoying and expensive inconveniences. According to Mr. McDuffee, a city that owns an airport has gone only half way if it does not provide proper transportation to and from it. Very few cities in the country have adequately met the situation at the present time.

Technical Abstracts

LIFT DISTRIBUTION ON MONOPLANE WINGS

CALCULATION OF TAPERED MONOPLANE WINGS, *by E. Amstutz, N. A. C. A. Technical Memorandum No. 578.*

THIS paper, a translation from *Schweizerische Bauzeitung,* is a mathematical treatment of the distribution of lift on monoplane wings with taper of plan form. Several recent designs, of this character, although excellent forms of construction statically, have aerodynamic disadvantages which must be considered carefully if failures are to be avoided, and it is to such problems that this discussion is devoted.

The work is divided into two parts: (1) the calculation of optimum wing shape for a given lift distribution, and (2) the calculation of the lift distribution for a given wing.

A wing is characterized by its plan form or contour t (ξ), its profile, and its warping $\delta(\xi)$, where t is the chord at distance x from the axis of symmetry, b = span, $\xi = \frac{2x}{b}$ and α = angle of attack. It is first assumed that the relationship between lift coefficient and the angle of attack is linear, this being a reasonable assumption within the working range. It is then deduced that the wing form $t(\xi)$ is not fixed, but depends on the warping $\delta(\xi)$ for a given circulation distribution. Two cases can then be considered: the flat wing and the warped wing. For the flat wing the circulation distribution is found to be independent of the angle of attack, and $t(\xi)$ is a function of the ratio of the central chord to the span for a given circulation distribution.

To illustrate the application of the procedure, an example is worked out, the circulation being determined for a flat wing with given span, central chord, airfoil section, and maximum thickness For comparison the wing of minimum induced drag with the same area and span is given. and the induced drag, bending moments, and torsional moments of the two wings are compared.

For the warped wing, the contour $t(\xi)$ is assumed and the warping $\delta(\xi)$ required to produce the desired lift distribution is calculated. The solution is arrived at indirectly by first calculating the lift coefficients $C_{a\infty}$ corresponding to the geometrical angles of attack $\alpha\infty = \alpha\infty_o + \delta\ (\xi)$, and then proceeding, according to the experimentally known relation between C_a and α to $\alpha\infty$ and then to δ. The index ∞ is used, because for a wing of infinite span, the induced velocity vanishes and the geometrical angle of attack equals the actual angle of attack.

To determine the lift distribution for a given wing requires an infinite number of parameters, strictly speaking. Actually however, a reasonable approximation can be made using only α and β, the coefficients in Prandtl's equation for circulation around an airfoil. The use of these two gives complete agreement at four points along the half-span, namely, in the middle of the wings and at the tips (where the circulation must sink to zero), and also for any two selected intervening points. For these intermediate values, ξ_1 and ξ_2, two conditional equations are established, the solution of which gives the desired parameters, α and β.

To aid in stability calculations, a formula is given by which an estimate can be made of the downwash of a tapered wing. The formula gives the ratio of the downwash velocities for the tapered and elliptical wings on the wings themselves, based on equal lift.

PROPERTIES OF WOOD GLUES

GLUING WOOD IN AIRPLANE MANUFACTURE; *by T. R. Truax; Technical Bulletin No. 205, Department of Agriculture; Washington, D. C.*

THIS very complete bulletin very competently fills a place in the series of publications on the use of wood in aircraft issued by the Forest Products Laboratory. In spite of the inroads of duralumin and steel in certain departments of airplane construction, and the threat of beryllium of future developments, wood is still as important as any other material in the manufacture of aircraft, and certainly bids well to hold its important position for some years to come. The use of glued joints has always been, and will undoubtedly remain inseparable from the use of wood in aircraft. This bulletin should therefore be of permanent and definite interest to all engineers and manufacturers in the industry.

While consideration of blood-albumin and animal glues is included in the bulletin, chief interest is centered in the casein glues, whose high strength, water resisting properties and its characteristic of being mixed with cold water and applied without heat, has put it into the front rank for aeronautical purposes.

There are rather complete descriptions of the properties of various types of glues, the effect of moisture, protection against deterioration and standard testing. Of practical interest are the discussions of preparation of the glues and of the wood before assembly into joints. Such questions as consistency of the glue and its application and the length and amount of pressure applied during clamping, are completely covered.

Of less direct interest to the average airplane factory but still of value to some parts of the industry are the complete formulas and specifications for manufacturing the various types of glue and discussions of plywood and propeller gluing technique.

STRENGTH OF CONTINUOUS BEAMS

A METHOD OF CALCULATING THE ULTIMATE STRENGTH OF CONTINUOUS BEAMS, *by J. A. Newlin and Geo. W. Trayer; N.A.C.A. Technical Report No. 347.*

IN employing the usual theory of three moments to calculate maximum load conditions, it is assumed that the relation of moments does not change when the elastic limit of the material is passed. When, however, the elastic limit of the material has been exceeded at some point in the beam, the stiffness of the beam at that point is necessarily reduced, and this change of stiffness is accompanied by a shift in the points of contraflexure and a concomitant redistribution of moments. The method of calculating the ultimate strength of continuous beams as developed in this report is based upon the principle that if a continuous beam is stiffened between two successive points of contraflexure, these points of contraflexure will move away from the stiffened portion with a resulting increase in moment at that point, and vice versa.

The major part of the experimental

work was devoted to determining the actual ratio of the maximum moments in the span and at the supports at the time of failure, as compared with the corresponding ratio while all the stresses were still within the elastic limit. Over 300 beams were tested.

For a transversely loaded continuous beam of uniform cross-section the proposed method of calculating the maximum load is very simple. The moments at the center support and the maximum load in the span should be calculated by the ordinary three moment equation. With the ratio of the latter to the former, which is the true ratio within the elastic limit, find the moment factor from the curve. This moment factor is the true ratio of the moments at maximum load. Express the moment at the center support and the maximum moment in the span in terms of the loads and reactions, multiply the moment at the center support by the moment factor and equate to the maximum moment in the span. Solve for the reaction in terms of the loads, and calculate the maximum moment using these reactions. The maximum loads can then be estimated by the usual formula, $M = \frac{fI}{y}$.

If the beam is reinforced at the supports as is customary in airplane spars, first consider it to be of uniform cross-section throughout its length, compute the relation of maximum moment in any span to that at the adjoining support having the greater moment, by the usual equation of three moments. Then take from the curve the moment factor corresponding to the relation thus computed. This moment factor tells to what fraction of its capacity the section in the span is stressed when the reinforced section at the support reaches its ultimate capacity. Using this ratio and calculating the moments in terms of the loads and reactions as before, the maximum loads which the beam will carry can easily be calculated.

Application of the proposed method of calculation to continuous members subjected to combined axial and transverse loads is somewhat more difficult than for the beam with side load alone. The first step is to determine where the points of contraflexure will be when the maximum load is reached. If these points are known, consideration of the problem may be restricted to the portion of the beam between two successive points of contraflexure or between a point of contraflexure and a hinged end, with a resulting simplification of the solution for each span. This solution will then involve merely the solution of a column under combined loading. However, when the section at the support is stressed to its maximum capacity, the section out in the portion of the span suspended between two points of contraflexure has to be limited to a certain fraction of its stress capacity, and hence it is necessary only to investigate conditions out in the span.

As previously stated, the relation of moments for transverse load only is calculated by means of the usual equation of three moments, with the assumption that the cross-section is uniform throughout. Moment factors are then taken from the curve, and considering one span at a time the positions of the points of contraflexure are located. The positions as thus determined will not coincide exactly with their position at maximum load under combined loading, but calculations and tests have shown that the differences are so small that they can be neglected with safety. Knowing the points of contraflexure, the sections suspended between them in each span can be investigated. Under combined loading that section is limited to a certain fraction of its stress capacity. For transverse load only this fraction is the moment factor but, with axial loads present, the fraction of stress capacity may be increased as follows:

Let K = moment factor, ρ = ratio of direct stress to total stress, U = maximum load modulus at the ratio ρ. Then the design modulus for the portion of the beam out in the span is $KU + \rho\,(U - KU)$.

The proposed method of calculating the ultimate strength of continuous beams is not only simpler than any other method yet suggested, but hundreds of tests have demonstrated that it gives accurate results. Maximum loads as obtained by this method for beams of rectangular section, and checked by tests, were, on the average, 25 per cent in excess of those calculated by the usual methods. For I beams the average increase was about 40 per cent. This discrepancy is too great to be neglected in good design.

What Our Readers Say

In Defense of Leather

To the Editor:

Referring to Mr. Hardecker's article, "The Interior Decorator Has His Day," which appeared in the February, 1931, issue of Aviation, I agree that it is time for the designer to direct his attention to interior appointments. He should realize that money or material so used are wasted unless they help sell his airplane. A large number of people unfamiliar with airplanes comment on the apparent delicacy of their construction. Materials which are light in weight, non-inflammable, available in many colors and patterns, and yet have the appearance of strength and solidity are therefore to be desired.

Mohairs and velvets are mentioned as having a soft clinging pile which prevents the occupant from sliding around in his seat. In the first place, airplane seats are so narrow and shallow that there is no room for persons occupying them to slide around, and secondly, why convey the impression that riding in an airplane is so rough that a person is likely to slip from his seat? People do not slip from their seats in motor boats which have the same rolling and pitching motion.

Pile fabrics, in the writer's judgment, are not as sanitary as genuine leather, as they soil easily from grease and retain germs resulting from airsickness. The fact that pile fabrics are porous and permit free circulation of air and dust is in itself against their use as this allows dust and dirt, as well as germs to penetrate to the cushioning material, where they remain. You can clean the surface of pile fabrics, but what about the underside?

Imitation leathers can be cleaned with soap and water, do not collect dust, and may be had in many pleasing colors and patterns. They are extremely inflammable, however, and will crack and peel in warm weather. Imitation leather is cold to the touch in cold weather and will not stand as much wear as genuine leather.

Mr. Hardecker's comments on genuine leather are very timely and are within reason as this material will not absorb dust, grease, or germs, and can be cleared with soap and water, and there are special leathers made for aircraft which are lighter in weight than ordinary leathers, mohairs. imitation leathers, etc. These materials are not inflammable, soft and warm in the winter, and cool in the summer. Genuine leather takes on a deep, rich natural tone with age. The following table of comparative weights will be interesting:

Material	Weight in ounces per sq.ft.
Sateen	1.60
Moleskin	1.75 to 2.16
Genuine Leather (aviation grade)	1.5 to 1.75

Permit me to advance the thought that the big reason for the aircraft manufacturers using materials other than leather is that they buy in small quantities and look to the nearest jobber to supply them with cut pieces from anything he has in stock. Any aircraft manufacturer who can allow ten days or two weeks time to get material can secure genuine leather in two or three hide lots direct from the manufacturers.

J. E. Menaugh

The J. E. Menaugh Company
Chicago, Ill.

Airport Management

The waiting and lounging room at Westchester Airport

Facilities for hop passengers

WESTCHESTER Airport Corporation, operator of the airport of that name in Armonk, N. Y., has installed a waiting and lounging room with two outstanding features. Passenger hopping is one of the company's chief activities and special pains have been taken to attract patrons and make them comfortable while waiting their turn to fly.

The waiting passenger does not have to stand in the open exposed to the elements or blasts from the propeller of a taxiing plane. He goes into the waiting room to buy his ticket or await the ride, and while there he may be seated. There are wicker chairs and divans facing the wide windows on the airport sides of the room, magazines to read, a map of the United States airways and one of Westchester County to inspect. And while waiting he need not miss a thing going on out on the airport, the windows affording an unobstructed view of all operations.

To handle specially large groups of waiting passengers—and they have them at Westchester on week-ends and holidays—a passageway, formed by two parellel rails 4 ft. apart and about 30 ft. long, has been provided back of the row of chairs and divans. The rails are of pipe and are raised about 4 ft. above the floor. Here the prospective riders may be kept in line for their turn, still in full view of activities and protected from dust and slipstream.

The room itself measures 49x23½ ft. and is on the port side of the administration building. It is connected with the front offices and salesroom, and may be entered directly from the street or field by three doors. Electric fans have been installed for summer use.

Navy tries illuminated weather maps

AN illuminated weather map has been installed at the Naval Air Station at Anacostia as an experiment in making prevailing weather conditions along most of the Atlantic seaboard as easy to visualize and as up-to-the-minute as possible. Similar installations at San Diego and Hampton Roads may be made.

The map itself is of black lines on a glazed glass panel attached to the wall. Each weather reporting point is marked by the name and a large circle, behind which (in the rear of the glass) are small electric bulbs of different colors. A circle is illuminated by a white light when good flying conditions exist at that point. A green light indicates undesirable flying weather, and fog and severe winds by red. Two colors appearing in a circle indicate an expected change in conditions.

An important feature of the device is the ringing of a bell when a light is changed, giving immediate notice to all within hearing that a new condition has been reported. Sudden and violent conditions, such as squalls, thunder storms, are emphasized by the prolonged ringing of the bell. Weather information is quickly disseminated since there is one of these maps in the office of the commanding officer, one in the pilots' ready room and one in the meteorological office.

The map is supplemented by a panel of lights, located to the right, which gives detailed information of conditions in each zone. Down the left side of this panel are topics and lights covering local conditions. On the right side are three columns—one for each zone—with such topics as low clouds, fog, visibility less than ½ mi., high winds, becoming worse, and so on. At the bottom of this panel are indicated the wind velocity and direction at 3,000 ft. in each zone.

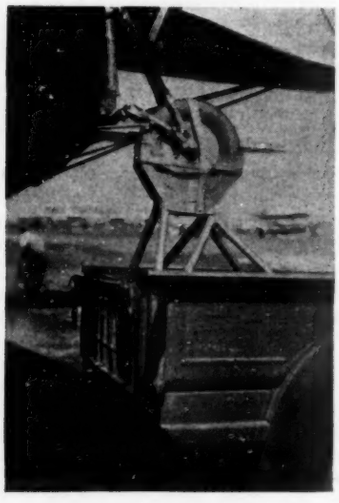
If the information on the map becomes two hours old, all the lights are extinguished. The switches are below the map in the meteorological office where the device was developed by Lieut. J. B. Anderson, meteorological officer.

The Navy's illuminated weather map, demonstrated by Lieutenant Anderson, who directed its development

Servicing Short Cuts

SWINGING THE COMPASS

COMPENSATING compasses on the Stinson tri-engined planes of the Ludington Lines at the Washington repair shops is greatly facilitated by the use of a special tail wheel cradle mounted on the rear of a small automobile truck. The apparatus is built up of steel tubing and channels welded together, and held down on the truck platform by four bolts. With the tail wheel resting in the cradle the airplane is supported in flying position. A clamping band on the cradle holds the wheel firmly in place and makes it possible to tow the plane with the truck without danger of the wheel slipping out of the cradle.

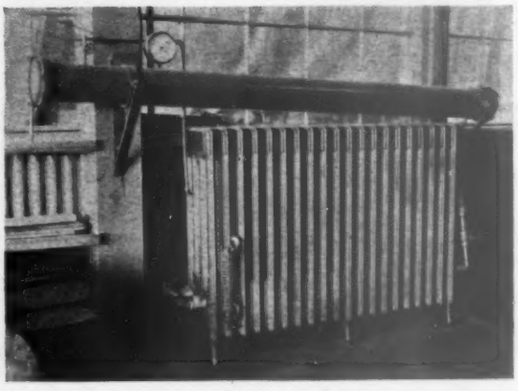


Close up of Ludington tail wheel cradle

In adjusting compasses a level spot on the field or apron is selected from which certain known directional reference marks are visible. The truck supporting the tail wheel is stationed so that its axis is at 90 deg. to the thrust-line of the plane. A pelorus is set up on the center section of the wing, and the North-South line established. By driving the truck around in a circle about the main landing wheels as a center, the airplane may be readily swung through the 360 deg. necessary to calibrate the compass. Two men are required for the operation,—one to sight the pelorus, and one to drive the truck. The latter enters the cockpit after each setting of the airplane, and makes the required entries on the compass correction card.

A WOOD STEAMER FOR THE SMALL SHOP

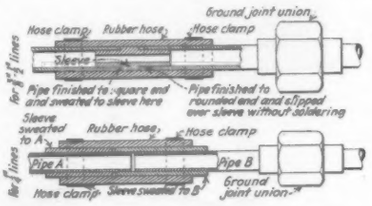
A UNIQUE wood steamer has been developed for use in the wood working shop at the Boeing School of Aeronautics at Oakland, Cal. Although the amount of wood steamed is too small to justify installation of a large unit, some steaming must be done. An 8-ft. length of 6-in. pipe was attached to a gas-steam radiator which is part of the shop heating equipment. Steam from the radiator is lead directly into the pipe. A small valve regulates the admission of steam, and a gage shows the pressure in the chamber. One end of the casing is closed with a permanent cap and the other fitted with one which can be readily removed by means of handles bolted to it. Strips of wood up to 8 ft. long and 5 in. wide can be accommodated.



Radiator and wood steamer

FLEXIBLE JOINTS IN FUEL LINES

TO prevent fatigue failure in lines used to supply fuel and oil to an airplane engine some sort of flexible connection must be made between the point where the line leaves the fuselage structure and the point where it is attached to the engine. Two types which have given very good results in service are shown in the accompanying illustration. The arrangement in the upper part of the cut shows a connection suitable for tubing $\frac{3}{8}$ in. in diameter or larger, and the lower one shows the joint designed for $\frac{1}{4}$-in. line. Details of the two methods are clearly shown. After a short time in service the rubber hose under the clamps adheres very tightly to the tubing, and in order to avoid disturbing the joint when it is necessary for lines to be disconnected, a standard ground joint union is inserted adjacent to the flexible joint.



Flexible connections for copper tubing

PROTECTING ENGINE CYLINDERS

A COMBINATION of moist salty air and flying sand encountered at the T. C. Ryan Airport at San Diego, Cal., makes it difficult to protect exposed engine parts against corrosion and abrasion by the use of ordinary cylinder paint or enamel. After considerable experimental work, it was found that a special Portland cement paint, known as L & S Portland Cement No. 3823, manufactured by the General Paint Corporation gave good results. When applied to cylinders its produces a rough black surface which adheres well to the metal, and resists the blasting action of flying sand and the corrosion of salt air. The paint requires several days to dry properly, however, during which time cylinders and other parts must be thoroughly protected. Satisfactory results have been obtained by first reconditioning and assembling the valve mechanism of each cylinder and covering all exposed parts with tape. The paint is then applied by means of a spray gun and the cylinder set aside in a protected location to dry. When thoroughly dry, the taping is removed from the valve gear and the cylinders are ready for immediate assembly to the crankcase.

Design Novelties

Tail wheel assembly

TO avoid the expense of continual tail skid replacement and the damage and dust which a skid causes in landing on a dry field, Mr. J. E. Steinhauer, assistant manager of operations at the Washington-Hoover Airport, designed a simple tail wheel assembly which may be substituted for the skid with practically no change in the structure of the average airplane. The equipment was installed originally on a New Standard D-25 four-passenger airplane used for sightseeing trips over the city of Washington, but is also available for other types.

A 5.00x4 tire mounted on an aluminum alloy hub is carried in a small fork made up of welded steel tubing. The shank of the fork slides into a steel tube sleeve which contains a series of rubber compression discs so arranged that landing shocks are absorbed by the rubber. The outer sleeve is fastened to the fuselage by means of suitable welded-on steel brackets. The use of the wheel has materially reduced the $900 a year repair bill which was charged against the skid in the course of a year's operation.

Tail wheel assembly installed on a New Standard biplane

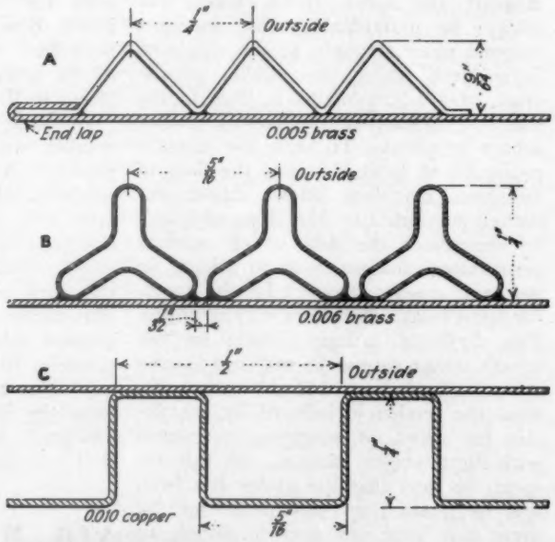
Rigid type landing gear

THE Waco Aircraft Company of Troy, Ohio, recently exhibited a machine equipped with a landing gear which differs from the ordinary in that all main structural members are rigidly attached to the fuselage, and shock is absorbed by telescoping a splined shaft attached to the wheel into one of the fixed struts. The motion of the shaft and wheel is controlled by an oleo gear mounted inside the stationary strut near the point of attachment to the fuselage. The strut is braced fore and aft by a steel tube welded to the lower end and extending rearward into the lower longeron. Both members are enclosed in a common faring. Transversely, both halves of the undercarriage are braced by a single pair of cross tubular tension members. A flexible boot (folded back in the illustration to show the details of the wheel connections) protects the moving parts from dirt, retains grease and oil, and forms a relatively smooth covering when the machine is in the air with wheels in the full down position.

The Waco rigid landing gear

Wing type radiators

ELSEWHERE in this issue reference is made to the results obtained from the use of wing radiators on racing airplanes. The accompanying series of cuts, taken from Mr. G. A. Luburg's paper "Wing Radiator Development" read at the Baltimore Meeting of the A.S.M.E. recently, illustrate three typical methods of construction for such



Typical wing radiator sections: A, corrugated (Curtiss); B, tubular (Curtiss); and C, smooth skin (Supermarine). Below: Characteristics of various wing radiator installations

Airplane and type	Army Racer 1922 (A)	Page Racer 1930 (B)	Supermarine 1927 (C)
Cooling area (sq.ft)	244	285	284
Horsepower	460	770	875
Maximum speed	224	240	287
Total weight with water (lb.)	221	327	480
Weight of radiator skin only (lb.)	148	180	....
Weight per sq.ft. (lb.)	.907	1.190	1.700
Weight per hp. (lb.)	.480	.425	.550
Aera per h. (sq.ft.)	.530	.370	.325

equipment. Fig. A shows a section of the original corrugated Curtiss radiator. The completed sections for the upper and lower wing surface were assembled with headers at the leading and trailing edges, and attached to the airplane by sliding as an envelope over the wing. Construction and maintenance difficulties led to the modification shown in Fig. B, which represents the installation used in the Page Racer of 1930. In this case, individual tubes were sweated into headers at the leading and trailing edges. Both these types are independent of the wing structure, and serve merely as radiators. The Supermarine Company in England developed the design shown at Fig. C wherein not only is the drag reduced by elimination of the exposed corrugations, but the radiator is built as a part of the wing structure, and takes part of the wing drag and torsional loads. The use of copper instead of brass resulted in an increase in weight, but the rate of heat dissipation was much improved. The accompanying table gives the comparative characteristics of the three types.

GLIDING AND SOARING FOR THE FUN OF IT

SAILING THE SKIES, *by Malcolm Ross; The MacMillan Company, New York City, 1931; 274 pages; $2.50.*

IN SPITE of the modern demand for speed and more speed, there will always be individuals whose instincts respond more strongly to the ripple of horse flesh under the saddle, or the crack of a jibing mainsail, than to the roar of unleashed mechanical power ashore or afloat. To such, the recently rediscovered sport of sailing the skies in motorless machines offers almost unlimited possibilities. Mr. Ross, although he recognizes the debt which modern aeronautical science owes to gliding in the past, appeals strongly for the sport-for-sport's-sake aspects of soaring flight. The thrill of sailing silently on the wind's wings cannot be matched in any other field of sport, and the author decries the tendency, induced by the desire for speed, of equipping sailplanes with light weight engines. In this respect, he says that the glider has been less fortunate than the horse, for "if there had been any way to attach an outboard motor to a horse some fanatic would long since have done it, but neither end of the horse seemed adapted to the purpose, and Dobbin was saved for the world for pure sport."

In "Sailing the Skies" Mr. Ross has achieved that happy combination of sound information and good writing which goes to make any book interesting as well as valuable. He carries the reader in an easy, understandable fashion through enough of the theory and history of motorless flight to furnish a background for his description of modern machines and methods, and, as the ultimate ambition of every glider enthusiast is, or should be, true soaring flight, he brings the book to a climax in two final chapters on sailplanes. Here those men whose names are interwoven with the history of soaring flight,—Hirth, Bowlus, Barnaby, and others, are permitted to give first-hand testimony of the rewards which riding the winds offers to the sportsman pilot.

A background of wartime flying, coupled with writing and editorial experience and an intense interest in modern gliding makes Mr. Ross particularly well fitted to chronicle the history and possibilities of this latest American sport. Not a little of the readability of the book is derived from its wealth of illustrative material, both in photographic and anectodal form. Two appendices have been included, "A Practical Manual for Glider Pilot Instructors," by W. F. Barnwell, and "Glider Design," by William J. Perfield.—S. PAUL JOHNSTON.

AIR MAIL STORY FOR BOYS

COURIERS OF THE CLOUDS, *by Edward Shenton; Macrae-Smith Company, Philadelphia, Pa.; 202 pages; $2.50.*

INSTEAD of being dubbed the story of the air mail, this volume may be classified as *a story* of the air mail. Dedicated to "the boys of today who will be the pilots of tomorrow," the book is of chief interest to them. It describes air mail operations in all of its departments and reaches its peak in accounts of thrilling individual exploits. It is not to be taken as a saga of the air mail—due to recent air mail policy changes it is a little out of date and there are a number of historical errors —but as a boy's book combining adventure, pioneering and history in varying degrees, it is interesting.—CHARLES H. GALE.

AIRPORTS IN ITALY

TRADE INFORMATION BULLETIN No. 721, *of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce; Washington, D. C.; 59 pages; $.10.*

THIS interesting publication covers the military, civil, and emergency fields now in operation in Italy. It is similar to the recently released description of airports in South America. The important ports of each type are described in considerable detail, including physical make-up and surroundings, service characteristics and prevailing weather conditions.

Following the descriptions of individual airports, there is an appendix covering fees for private aircraft at government airports; legislation concerning customs airports, as established by the federal government; a description of obligatory routes for passage over Italian boundaries; descriptions of zones which are closed to civil and foreign air navigation; and the customs procedure. The material has been compiled by Laurence E. Ring.—CHARLES H. GALE.

THE AIRPLANE, MODERNIZED

THE AIRPLANE, *by Frederick Bedell, Ph. D.; rewritten and enlarged with the assistance of Theodore E. Thompson, M. E.; D. Van Nostrand Company, New York, 1930.*

THE first thirteen chapters of this volume were first published in three separate works between 1918 and 1920. They have been more or less enlarged and modernized, and to them are added chapters on The Engine, Instruments, The Construction of the Spirit of St. Louis, Special Types of Aircraft, such as the Tanager and the Autogiro, and Outstanding Problems of Aviation, mostly navigation.

The author admits in his preface that he "has been spurred on in his attempt to meet the needs of the flyer and designer on the one hand, and of the general reader on the other." A perusal of the resulting book might lead one to suspect that it is too technical for the pilot and general reader and not advanced enough to be of great aid to the designer.—DANIEL SAYRE.

The Buyers' Log Book

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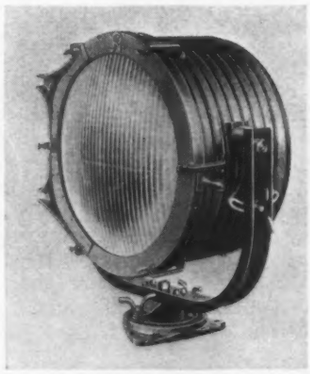
Airway code beacon

Manufactured in accordance with the newly revised regulations of the Department of Commerce, a new airway code beacon was recently exhibited by the Westinghouse Electric and Manufacturing Company, Edgewater Park, Cleveland, Ohio. The beacon shows three beams, one of 10,000 cp. in the horizontal plane, the second of 7,500 cp. at a higher angle, and a 3,500-cp. beam vertically. It can be arranged to flash a code signal to indicate a landing field, an established airway, or any reference point on which bearings may be taken.—AVIATION, *July, 1931.*

Code beacon

Aircraft radio equipment

New radio transmitting and receiving equipment, designed especially for use in one-man mail planes and small passenger transports where small bulk and low weight are essential requirements, is now being offered by the Radiomarine Corporation of America, 66 Broad St., New York City. The Type A receiver covers wave lengths from 30 to 1,500 m. The instrument itself weighs 9 lb., and the required battery 9½ lb., making the weight of the complete installation approximately 20 lb. The Type B transmitter has a rated antenna output of 10/15 watts on either constant wave telegraphy, or voice transmission, with 100 per cent modulation on the latter. It normally receives its power from a 500 d.c.-volt dynamotor regularly furnished with each installation. The dynamotor and tube filaments draw current from the regular 12-volt plane storage battery. The frequency range may be varied by means of plug-in coils so that a range of wave lengths from 31 to 111 m. may be covered. If required, provision can be made for operation at 600, 800, or 900 m. The transmitter proper, which is the largest single piece of equipment, is 11 in. high, 11½ in. wide, and 12½ in. long. The entire transmitting installation, including transmitter, control box, junction box, and dynamotor weighs 33 lb. 10 oz. —AVIATION, *July, 1931.*



Pyle-National floodlight

Floodlighting unit

The Pyle-National Company of Chicago has announced a new 36-in. floodlighting unit for airport use. The light is said to have a long range of projection with a maximum horizontal steam spread of 50 deg., a vertical spread of 6 deg., and a sharp steam cutoff at the top. It is furnished in either 3 or 5-kw. capacity, designed to use standard 32-volt or 115-volt lamps.—AVIATION, *July, 1931.*

Backfire trap

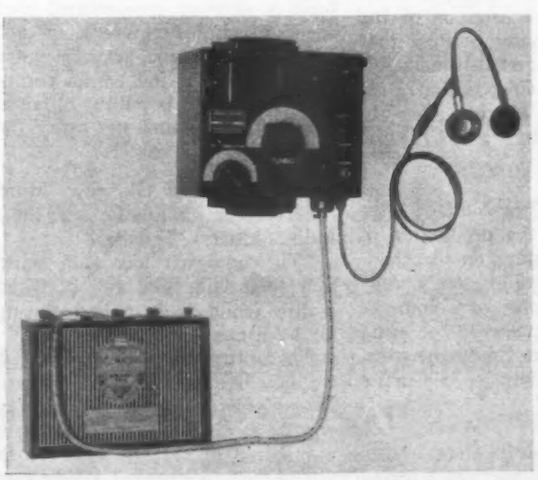
For automobile, marine and aircraft use, the M. L. Oberdorfer Brass Company of 2703 Thompson Road, Syracuse, N. Y., has placed on the market an attachment for the air-intake of a carburetor designed to prevent danger of fire from backfire explosions. It is claimed that normal engine operation is not affected.—AVIATION, *July, 1931.*

Shielded plugs

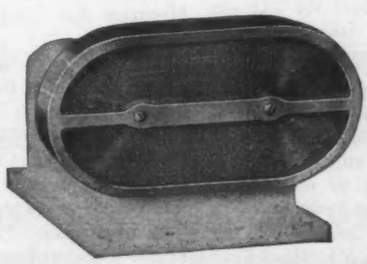
Complete electrical shielding and a specially designed center electrode which is said to reduce liability of fouling are the chief features of a new spark plug manufactured by the Walter Kidde & Company, Inc., of 140 Cedar St., New York City. The plugs are designed for any standard engine and can be tied in with any system of shielded wiring.—AVIATION, *July, 1931.*

Gasoline and oil storage

Several manufacturers of aircraft and automobile engines who use large quantities of gasoline and oil for test purposes have installed storage systems for these materials designed and built by Aqua Systems, Inc., 2 Lafayette St., New York, N. Y. The products of this concern include complete storage and distribution systems for all types of liquids lighter than water, such as paints, gasolines, oils, etc. The basic principals



The Radiomarine Type A receiver



Carburetor attachment to prevent backfire

are the flotation of the stored liquid over water, the maintenance of full storage tanks by the introduction of additional water as withdrawals are made, and the discharging of the stored liquid from the top of the tanks rather than from the bottom as is the case with the usual storage systems.—AVIATION, *July, 1931.*

Compass corrector

A new instrument designed to aid the navigator of water or aircraft has been announced by the Boston Yacht Sales, Inc., 126 State St., Boston, Mass. The instrument is known as the Adams Variation-Deviation Corrector and is used to correct compass errors. It consists of a movable arm and a movable celluloid disc mounted on a second and larger disc. Manipulation of the arm and disc in accordance with instructions which appear on the back yield the necessary correction for compensating for usual compass errors.—AVIATION, *July, 1931.*

Catalogs

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Parker-Kalon Corporation. Self-tapping sheet metal screws are being used in the aircraft industry for fastening metal parts, upholstery, fabrics, etc. The Parker-Kalon Corporation of 200 Varick St., New York, N. Y., manufacturers, have issued a bulletin describing applications of their products, including test results showing the strength of such fastenings in tension and shear.

The International Nickel Company. Specifications and data on the nickel bearing alloys used in Curtiss-Wright aircraft engines, together with a description of each engine, its parts, and its accomplishments, are covered in a new bulletin issued by the International Nickel Company of 67 Wall St., New York City. Copies of this bulletin may be obtained on request.

The B. G. Corporation. A booklet has been received from the B. G. Corporation of 136 West 52nd St., New York, describing the new B. G. radio shielded spark plug. The construction of the plugs and connectors for various shielding systems are illustrated by photographs and line drawings.

Westinghouse Electric & Manufacturing Company. Information covering applications of small sized power driven generators suitable for supplying electric current for lighting or other purposes in isolated locations is included in Bulletin No. A-60081 issued by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The title is "Westinghouse Small Generator Units and Their Application."

Side Slips

By ROBERT R. OSBORN

DURING the annual visit of representatives of the industry to Langley Field laboratories of the N.A.C.A., the new full scale wind tunnel was formally put into operation. This tunnel has a testing throat 60x30 ft. and can develop wind speeds up to 115 m.p.h. Mr. C.W.H. of Buffalo made the excellent suggestion that it would be an ideal place for the Department of Commerce to flight test some of the new light planes,—with plenty of mattresses on the floor.

We hadn't really realized that the industry was in a bad way until we made this trip to Langley Field with some of the leading manufacturers. All of them had bright and smiling faces, were smoking ten cent cigar after ten cent cigar, and were full of cheerful prophecies for the future. When they have that outlook, you know, it means they haven't an order in the plant and don't know where the next week's payroll is coming from. Don't ask us to explain why, but the species homo sapiens airplane manufacturer looks most downhearted when he is most prosperous.

This Month's Interview Prize is awarded to the Buffalo *Evening News* for is article on Col. Thomas C. Turner, on a recent visit to the Buffalo airport. The item states "He spoke highly of the flying area and facilities. He will leave as soon as the weather clears."

Miss H.L., our former demon Mexican correspondent, but now of Los Angeles, Cal., sends in a clipping from a contemporary magazine with the comment "Here is news of a new type you may wish to look into. If practicable there should be a ready sale for these in the drought-affected sections of the country." The clipping states that "Lawrence D. Bell, general manager, Consolidated Aircraft Corporation, Buffalo, N. Y., is in Mexico City to demonstrate a raining ship to the Mexican Air Corps."

Mr. C.B.A. of the New York *World-Telegram,* notes that the production of mystery planes is keeping up to schedule, from some information sent out by the Aeronautical Chamber of Commerce during the recent maneuvers. Listing the planes engaged in the maneuvers, they have under "Pursuits,—75 Curtiss Hawk Bombardment."

Mr. T.G. of New York discovers an engine described in an engineering publication which "develops 35 hp. at 25 r.p.m." and writes in to "find out if a reversible pitch prop might not enable the user of this engine to avoid embarrassment in a high wind?" He also adds at the end of his note "I think I am now entitled to my license as local attention caller. Please forward by freight prepaid. You can omit the electric stove that goes with it. I have one."

Mr. T.G. has omitted one detail of acquiring this license, which is to contribute ten dollars to the "Fund for the Retirement of All Jennies at Fifteen Years of Age," of which fund we are the administrator.

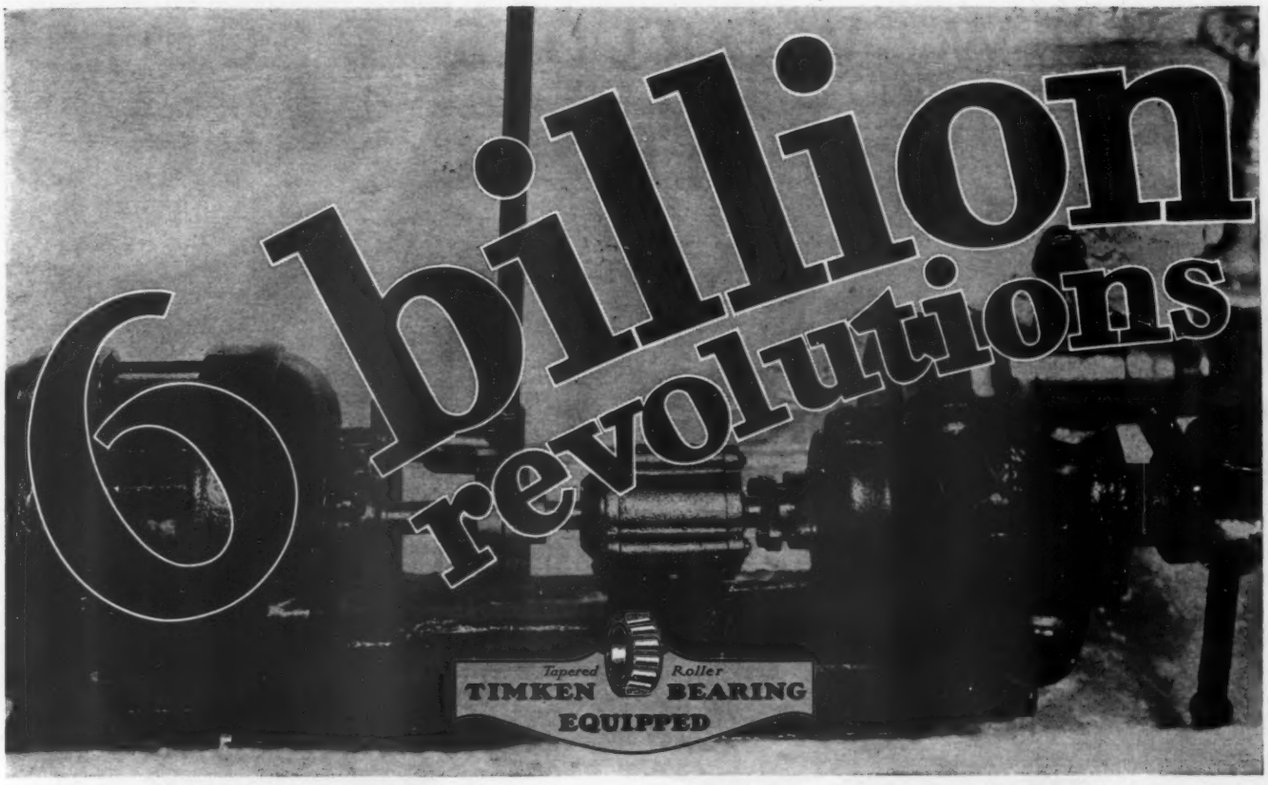
This feller, C. F. McR. who keeps us posted on things aeronautical on the Pacific coast bursts into the office with another batch of mail. In his first item he gleefully points out that a practical use has at last been found for the stunts of the California boys who change propellers, overhaul engines, and replace landing wheels in flight. They can, says he, remove the propellers which are now slowing up our aircraft after they reach 200 m.p.h. This suggestion is inspired by the following Associated Press dispatch printed in a California paper:

"One of aviation's fondest dreams, transport ships that will cruise at 250 miles an hour, will be realized when one of the simplest pieces of mechanism —the propeller—has been developed. Captain Carl S———, speed plane builder, believes. And the time, he adds, is not far off. The present speed has been reached by streamlining and the development of powerful motors. 'Right now we can go no further. We have built a ship so streamlined that at a speed of slightly more then 200 miles an hour the plane actually catches up with the motor and coasts through the air. The motor is pulling at tremendous speed but it cannot get away from the ship and pull it faster.'"

Mr. D.S.B. of Glasgow, Mont., discovered the following in the Great Falls (Mont.) *Tribune:*

"The autogiro has stub wings and four long wing-like motors which give it life while it is pulled through the air by a conventional propeller."

The autogiro has changed a bit since we saw one last, and we hereby warn Mr. Pitcairn that if he ever puts an electric stove in one we're going to start a publicity campaign to have the last Collier Trophy award reconsidered.



—and still going strong

Another Timken Bearing Service Record!

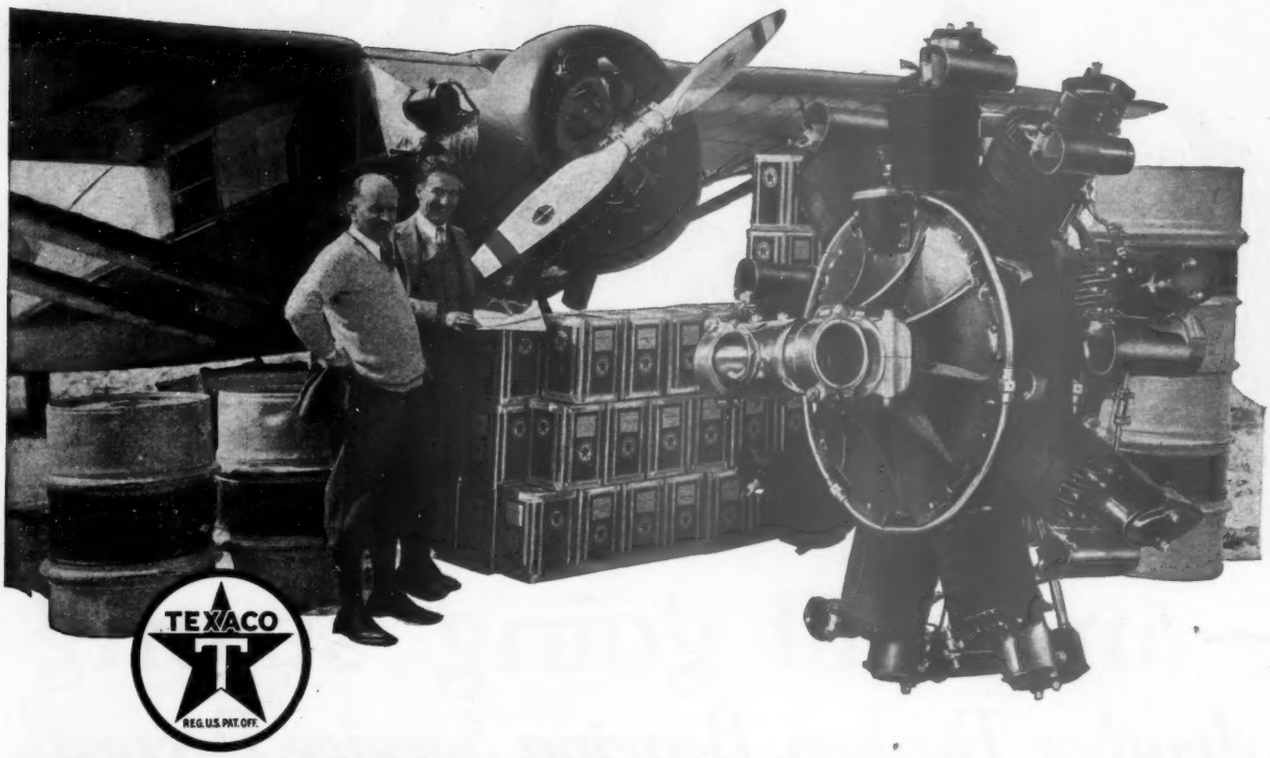
The Timken Roller Bearings in this Elliott pump installed in a large industrial plant have been in actual service over 4 years, averaging 20 hours a day, 6 days a week, with no attention except for lubrication.

During this time they have rolled up the staggering total of 6 billion revolutions at 3500 a minute—175 times the life of the average automobile—and a recent inspection showed them to be in perfect condition and good for billions more.

THE TIMKEN ROLLER BEARING COMPANY, LTD., TORONTO, ONTARIO

TIMKEN *Tapered Roller* BEARINGS

A NEW WORLD'S RECORD WITH TEXACO



TELEGRAM

ON OUR LAST FLIGHT, IN WHICH WE FINALLY MADE A NEW WORLD'S NON-REFUELING ENDURANCE RECORD, AS ON PREVIOUS FLIGHTS OUR PACKARD DIESEL ENGINE INSTALLED IN THE BELLANCA PLANE RAN PERFECTLY FROM START TO FINISH ON TEXACO AERODIESEL FUEL, TEXACO AIRPLANE OIL AND TEXACO MARFAK NUMBER 3 ROCKER ARM LUBRICANT. WHAT MORE COULD ANYONE ASK? WE WANT TO THANK THE TEXAS COMPANY FOR THE EXCELLENT COOPERATION WE RECEIVED THROUGHOUT ALL OF OUR THREE ATTEMPTS—

WALTER LEES AND FREDERIC BROSSY

Texaco Aviation Products include Texaco Aerodiesel Fuel, Texaco Aviation Gasoline, Texaco Airplane Oils, Texaco Marfak Greases and Texaco Asphalt products for runway construction at airport hangars.

THE Packard Diesel Aircraft Engine breaks the world's record in a *non-refueling* endurance test! A Bellanca plane powered by the Packard Diesel Aircraft Engine and flown by chief test-pilot Walter Lees and pilot Frederic Brossy remained in the air 84 hours and 33 minutes!

The plane took off from Jacksonville Beach, Florida at 6:47 A. M. May 25th and landed at 7:20 P. M., May 28th.

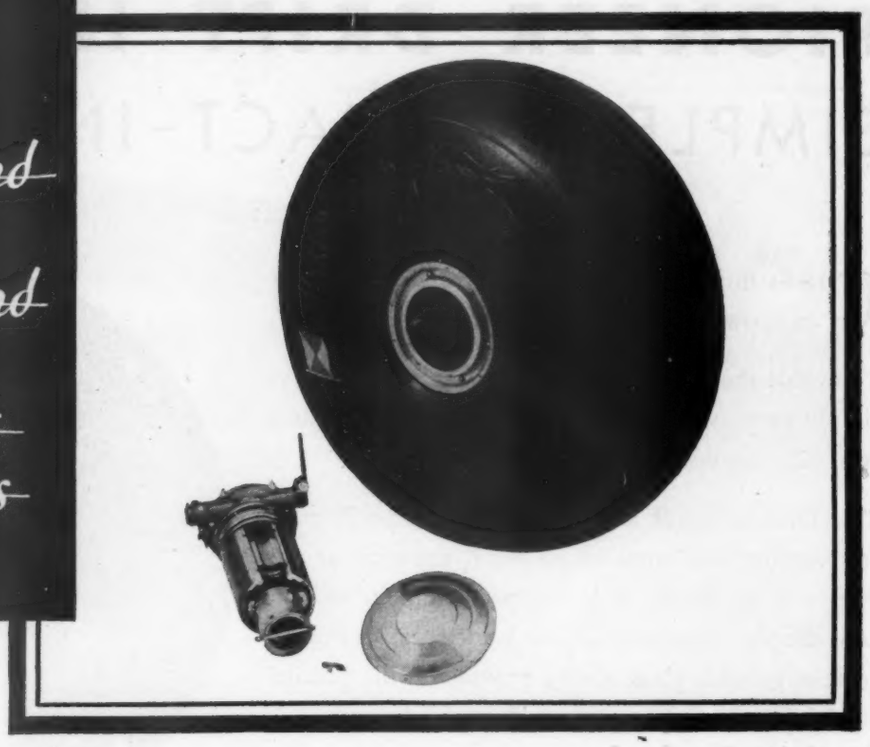
Texaco Aerodiesel Fuel, Texaco Airplane Oil No. 5 and Texaco Marfak Grease No. 3 fueled and lubricated the plane throughout the flight.

It was a remarkable demonstration of the power and endurance of this new type of engine, and of the exceptionally high quality of the fuel and lubricants that kept it functioning perfectly every minute of these long, trying hours in the air.

Both pilots were highly pleased with the performance of the Texaco Products they selected for this spectacular test. *Read the telegram.* These same Texaco Aviation Products are distributed at principal airports in every State.

THE TEXAS COMPANY
135 East 42nd Street New York City

~~Mud~~
~~Sand~~
~~Snow~~
~~Plowed Ground~~
Timber
~~Rolling Ground~~
Fog
~~Cross Winds~~
~~Small Fields~~
Water



Here's what we mean by "AIRWHEEL SAFETY"

Let your eye run down that list of landing hazards which threatened every pilot and plane before Goodyear developed Airwheels.

Then notice how few hazards are left on the list today.

Seven out of ten are banished by these big soft rolling rubber pillows — Goodyear Airwheels and the new Airwheel roller bearing brake.

Good luck and a good pilot may bring a ship through such landings *without Airwheels*—but the odds are three times as good if you have this Goodyear equipment.

Goodyear builds Airwheels to operate at inflation so low that you can roll the plane safely through mud, over sand, or across plowed ground without nosing over. And most pilots now know that this great wheel-and-tire-combined called an Airwheel makes cross-wind or down-wind landings a cinch.

Power, smoothness and *sure release* are combined in the new Airwheel brakes — the brakes developed exclusively for aviation. With these brakes you can slide the wheels or bring up the tail (depending on landing surface) and still keep complete control. You can hold the ship at full throttle — let it roll and *stop it again!* How's that for power?

Only Goodyear can give you Airwheel safety. *And now you can get it for no more than you pay for ordinary tire and wheel equipment.* Can you afford to fly without it? For engineering data, write or wire Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

When you buy a new ship specify Goodyear Airwheels

GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

THE NEW
PIONEER DRIFT INDICATOR
SIMPLE-COMPACT-INEXPENSIVE

IT IS as important to know the angle of drift as it is to know the compass heading of your objective.

To enable the pilot or navigator to ascertain drift as simply as possible the new Pioneer Drift Indicator, type 625, has been developed.

This Drift Indicator is one of the four new Pioneer Instruments that attracted so much attention at the National Air Show. It is compact, light in weight, and simply constructed. The principal parts are a rotable ground glass screen provided with parallel sight wires, and a lens inserted in the bottom of a funnel-shaped case.

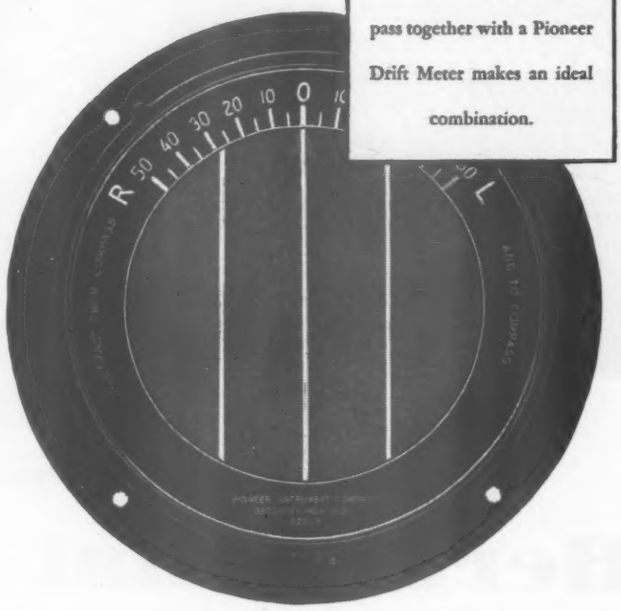
Ground Observations Made Easily and Quickly

To make an observation the screen is rotated until objects below appear to travel in a line parallel to the sight wires. Then the angle of drift may be read directly from the graduated scale. Whether it is to be added to or subtracted from the compass reading is plainly indicated.

In night flying, lighted objects show up on the screen with remarkable clearness. Pilot or navigator may thus make drift observations as readily at night as in the daytime, if ground lights of any nature are visible.

In order to get the most benefit from your compass you should supplement it with a Pioneer Drift Meter. This new instrument is so inexpensive you can hardly afford to be without it. Write for information and prices.

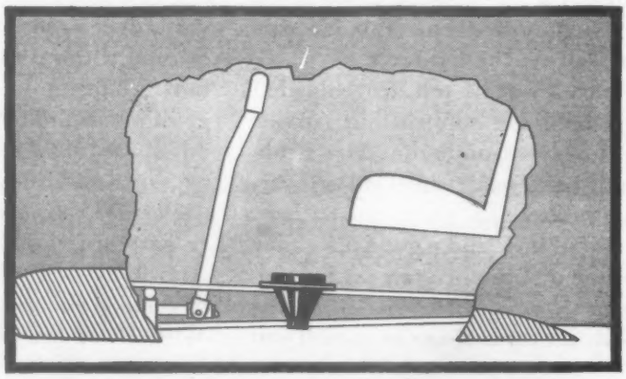
The use of a Pioneer Compass together with a Pioneer Drift Meter makes an ideal combination.



The above illustration is a top view of the Pioneer Indicator showing the sight wires and graduated scale.

A remote operated model is also available. It is known as type 642 and is rotated by means of a flexible shaft which is connected to a small crank unit mounted on the instrument board.

Type 625 Drift Indicator is mounted in the floor of the plane as shown below.



PIONEER INSTRUMENT COMPANY

INCORPORATED • • • DIVISION OF BENDIX AVIATION CORPORATION

754 LEXINGTON AVENUE • • • BROOKLYN NEW YORK

205 FIRST NATIONAL BANK BUILDING, DEARBORN • BENDIX BUILDING, LOS ANGELES • 15 SPEAR ST., SAN FRANCISCO • 5214 W. 63RD ST. CHICAGO • 527 SUSSEX ST. OTTAWA
STERNPLATZ 13 BERLIN-JOHANNISTHALL, GERMANY • • GENERAL EUROPEAN REPRESENTATIVE, M. CALDERARA, 47 AVENUE DE BRIMONT CHATOU S & O. FRANCE

P-31-14

FORD EXPRESS!

THE time has come for freight to fly! Transportation of passengers by air is already an established factor in business. So also is air transportation of mail.

The new Ford plane, designed primarily for freight, mail and express, first appeared at the National Aircraft Show in Detroit.

The wings and fuselage of the Ford Express conform to the specifications of the famous Model 5AT Ford transport. Its greatest distinguishing feature is that it is equipped with only one motor . . . a Hispano-Suiza 715-H.P. (American rating at 2000 r.p.m.) water-cooled engine.

PERFORMANCE SPECIFICATIONS ARE:

Pay load, 3500 pounds.

Useful load, 4900 pounds.

Weight of plane, 6100 pounds.

Gross weight carried by plane, 11,000 pounds.

High speed . . . 135 m.p.h.

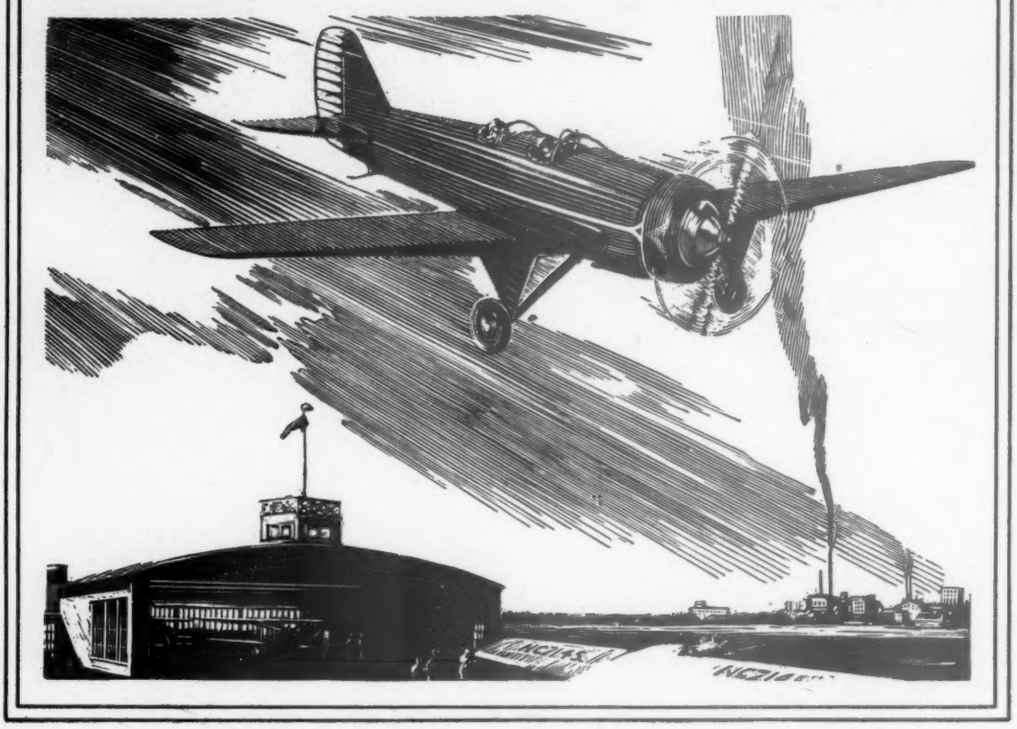
Cruising speed . . . 110 m.p.h.

Ceiling . . . 15,000 feet.

Rate of climb . . . 700 feet.

The Ford Express plane is specially valuable as a carrier where swift freight and express are at a premium.

• FORD MOTOR COMPANY •



Here's one place where ordinary oil won't do use PENNZOIL *costs less per flying hour*

Ask for PENNZOIL—
Not just "Pennsylvania Oil"

Good lubrication is one of the essentials of motor maintenance. Nearly any of the big air lines can tell you that. That's why they use Pennzoil Aircraft Oils. They're designed to get the last notch of speed out of your plane and keep it properly lubricated.

Pennzoil is economical. It increases the period between overhauls. It gives you thirty to forty hours to the filling. It costs less per flying hour. With Pennzoil, dependability and economy go hand in hand.

The PENNZOIL COMPANY: Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles
British-American Oil Co., Ltd., Sole Distributors in Ontario and Quebec, Canada

100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

PENNZOIL is made by the famous Pennzoil Process from 100% pure Pennsylvania crude and nothing else.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N

AIR TRANSPORTATION

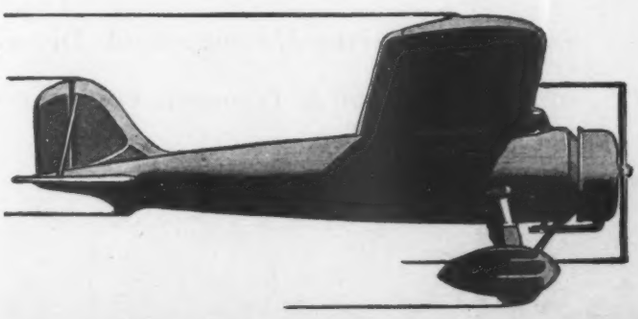
★ DEMANDS ★

GREATER SPEED

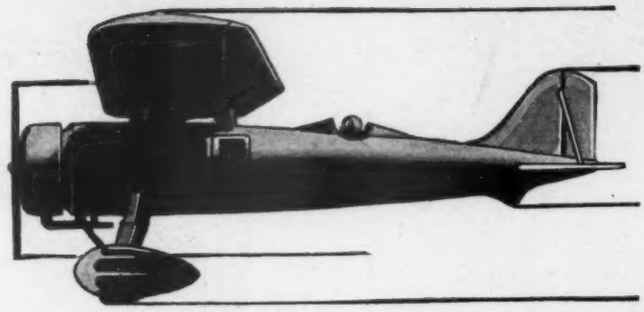
SPEED IS PROGRESS. For that reason the horse replaced the ox; railroads and automobiles the horse, and five-day boats drove white sails from the seven seas ★ Speed is the only reason for aviation. The transport operator must realize this. He must provide the speediest of all transportation. If he does not the world will go back to trains and motor cars.

Speed is the reason for the rugged construction—the stream-line design—the ample power (575 h.p.) of the Model 17 FLEETSTER . . . and its cruising range of 750 miles at 153 miles an hour ★ The Model 17 FLEETSTER was planned to meet the demands of the air traveler for speed and comfort. With ample baggage space, this eight-place, convertible landplane or seaplane will make money where a less speedy, reliable or popular plane, though larger, would carry a partial load at a loss. Proofs of the stability, safety, economy and performance of the Model 17 FLEETSTER for transport service or private ownership will be sent on request to anyone interested in economical air transportation.

MODEL 17 . . . A.T.C. 369



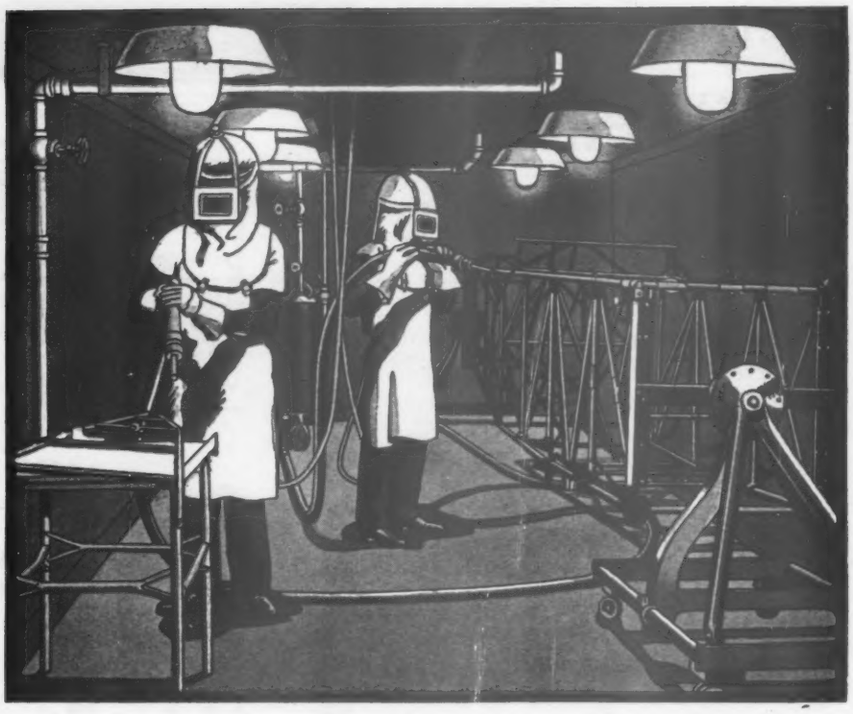
THE FLEETSTER



MODEL 20 . . . A.T.C. 320

AIR-PASSENGERS' demands for speed are incessant—but those of the air-mail and express service are imperative . . . Business is won—or lost—through success or failure in maintaining rigid schedules ★ High speed and suitable cargo capacity alone can make air transportation profitable—and popular. The Model 20 FLEETSTER is amply powered for its cruising range of 700 miles at 148 miles an hour . . . It arrives on time. Every cubic foot of its payload capacity serves a useful purpose. The pilot's rear cockpit permits the most efficient adaptation and arrangement of its useful load (2461 lbs.) to individual requirements for passenger, mail and express accommodations ★ The Model 20 FLEETSTER is more economical in operation and maintenance than any similar plane of its type. Every factor of its appeal to progressive transport operators is worthy of consideration by corporation executives whose widespread activities demand speed in the transportation of cargoes or personnel. Write for facts regarding the Model 20 FLEETSTER for all transport purposes.

CONSOLIDATED ★ AIRCRAFT ★ CORPORATION BUFFALO, N. Y.



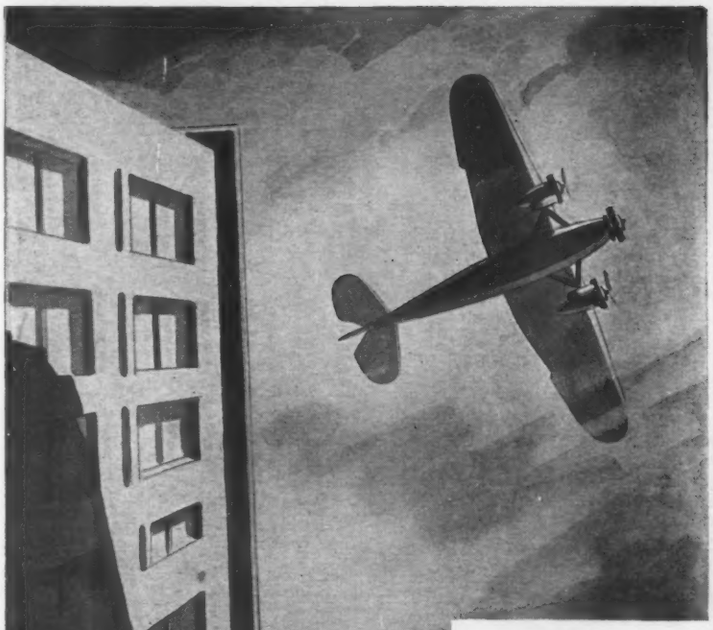
BUILDING CHANCE VOUGHT STAMINA INTO AIRPLANES

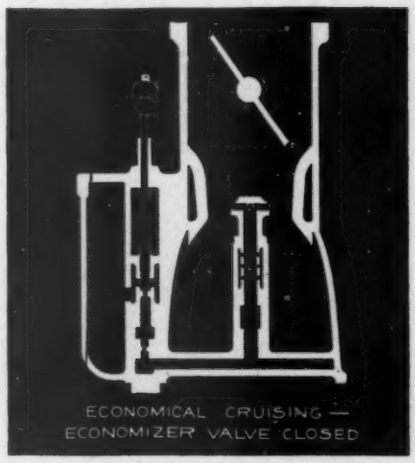
Metal parts on Chance Vought airplanes hold their finish. No landings in rough salt water—no dives through soaking clouds of rain—no penetrating fogs break through to start corrosion. Perched high on the exposed decks of Navy ships at sea, Vought planes are well protected against the lash of wind-blown spray.

Before the three protective coats of red oxide and enamel go on, the metal parts are cleaned and surfaced in the sandblasting room. Clouds of fine, sharp grains with a lusty pressure of air behind them remove every vestige of dirt and grease, producing a surface to which the finish hangs on through the toughest kind of service.

In the modern, sunlit Vought plant at East Hartford, you'll find the latest equipment and processes. And you will discover many ingenious methods and mechanisms which are as characteristically Vought as the ships themselves. Chance Vought Corporation, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.

CHANCE VOUGHT CORPORATION





ECONOMICAL CRUISING

MAXIMUM economy at part throttle or cruising speed has taken on a new meaning with the development of the Stromberg Aircraft Carburetor.

Two types of *Economizer Systems* contribute to this efficiency on Strombergs.

One is the *Needle Valve* type; the other, the *Piston* type. Both are operated by the throttle; both permit the carburetor to operate at maximum efficiency on a lean mixture at cruising speed and provide a rich, powerful mixture at full throttle.

Economical cruising is one of many reasons why Stromberg carburetors are used on over 95% of the aircraft engines now being built in the United States. Stromberg engineers will gladly help you with your own carburetion problems. Inquiries are invited.

STROMBERG CARBURETORS

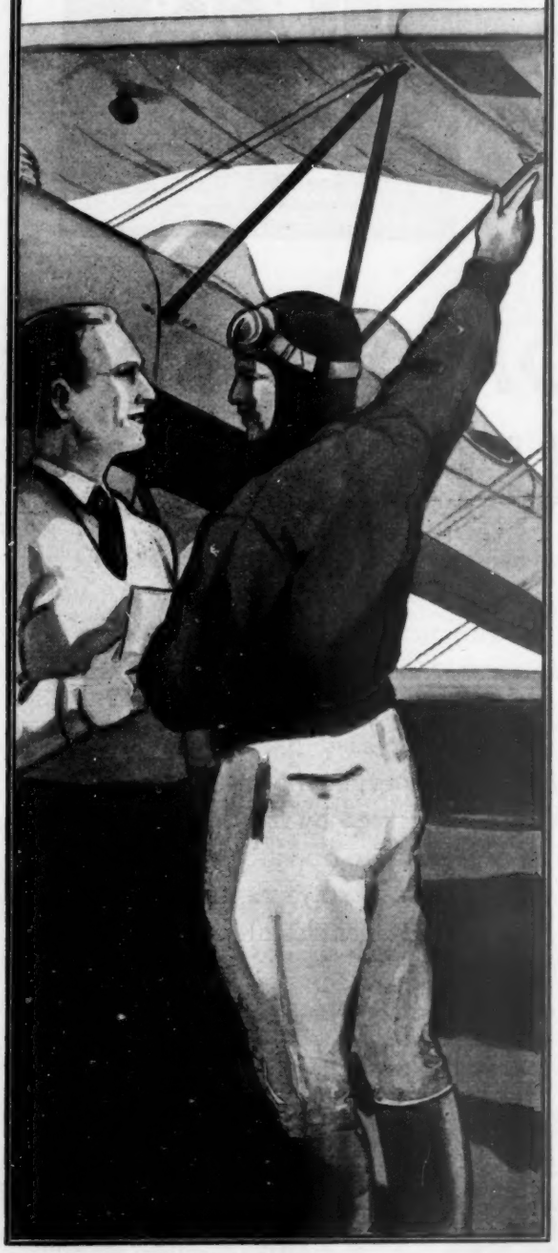
BENDIX STROMBERG CARBURETOR COMPANY

« SUBSIDIARY OF BENDIX AVIATION CORPORATION »

701 BENDIX DRIVE - SOUTH BEND, INDIANA

The 1931 GREAT LAKES *Sport Trainer*

$2985 Flyaway, Factory



CASH IN NOW ON THIS NEW INTEREST IN AVIATION!

With the coming of the 1931 Great Lakes Sport Trainer, there has been a sharp reawakening of interest by those who would take to the air in a practical way.

The greater beauty and stability of this staunch and dependable plane—always a popular choice for initial flight instruction—has aroused renewed interest from all parts of the country.

At the new price of $2985, the Sport Trainer is exactly the ship for those keen-minded followers of aviation who have been waiting for just such a popularly priced, *dependable* plane to get into the air at once.

This is the time when the complete details of the Great Lakes Sport Trainer should be in your hands. Write for them today.

***DEALERS**—The Great Lakes proposition contains so many merchandising advantages that you ought to have all the details at once. Write or wire immediately.*

GREAT LAKES AIRCRAFT
CORPORATION **CLEVELAND**
Contractors to the United States Army and Navy

Photo by R. I. Nesmith & Associates

Cut the Gun!—no flooding with Socony

800 feet up . . . cut the gun . . . get ready to set 'er down. Just as Socony Aviation Gasoline has powered your plane in flight, so you'll find no excess flooding at the carburetor when you cut the gun.

And if you should want to give 'er the gun again suddenly, she'll start climbing without a sputter. You can do that sort of thing easily when your plane is fueled with Socony Aviation Gasoline and lubricated with the New Socony Motor Oil.

SOCONY AVIATION GASOLINE

NEW SOCONY MOTOR OIL

SOCONY

STANDARD OIL COMPANY OF NEW YORK

a Battery *made* to fly

. . . light-weight . . . compact . . . safe

Exide Aircraft Batteries are especially built to meet rigid air requirements

Out of the black of night onto the field in safety. Landing lights can be depended on with Exides on the job.

The Exide Aircraft Battery is especially designed for hard flying service

THE most vital parts of a "ship" are dependent on the battery carried. Starting, ignition, cabin lights, avigation and landing lights, instrument board and radio must be certain of electric power. You *can* be sure with Exide Aircraft Batteries in your fuselage.

Exides are so designed that the electrolyte will not spill. They have proved their worth over millions of miles of sky lanes . . . in all kinds of weather.

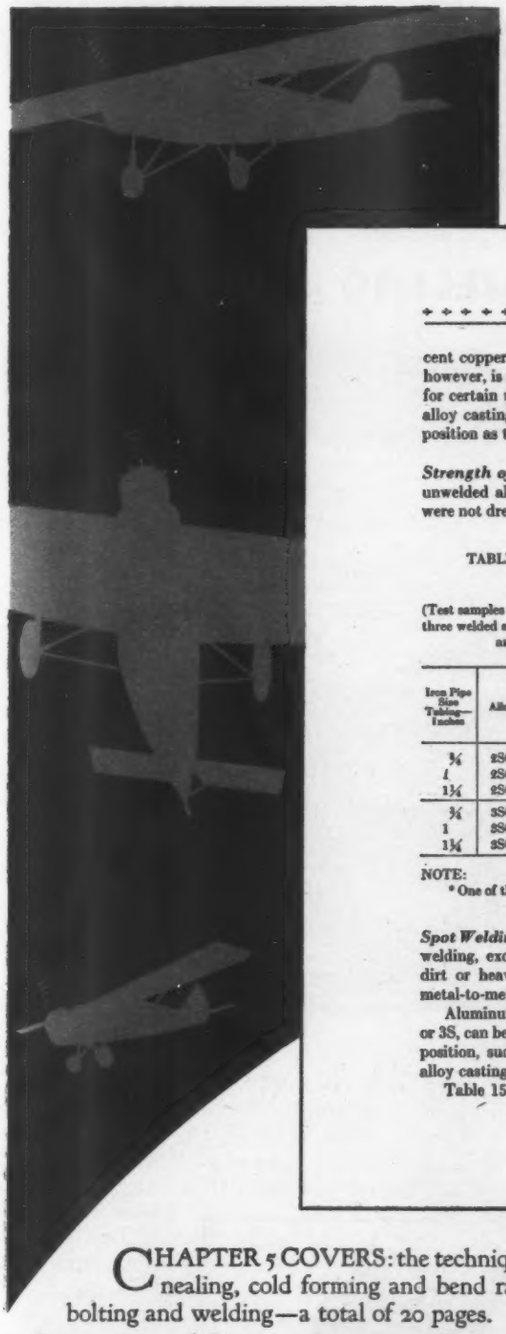
Ask your flying friends about Exides . . . about their reliability. Or write today for further information on the many types of Exide Aircraft Batteries and their varied applications.

Exide
AIRCRAFT
BATTERIES

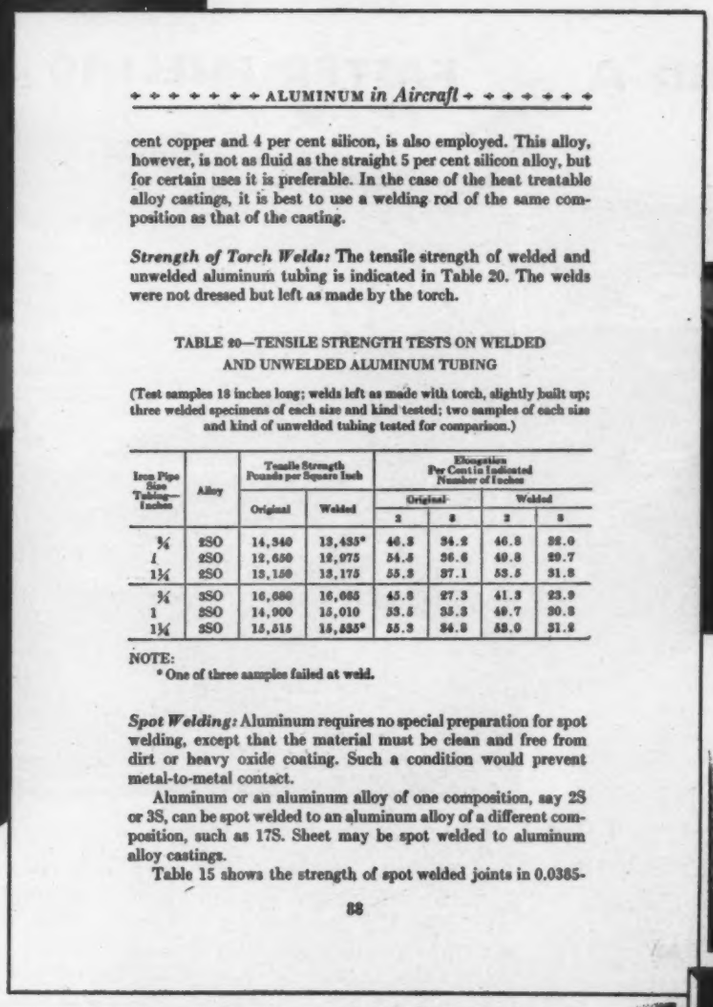
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto



If you're an engineer, or any other executive » » »



+ + + + + + + ALUMINUM *in Aircraft* + + + + + + +

cent copper and 4 per cent silicon, is also employed. This alloy, however, is not as fluid as the straight 5 per cent silicon alloy, but for certain uses it is preferable. In the case of the heat treatable alloy castings, it is best to use a welding rod of the same composition as that of the casting.

Strength of Torch Welds: The tensile strength of welded and unwelded aluminum tubing is indicated in Table 20. The welds were not dressed but left as made by the torch.

TABLE 20—TENSILE STRENGTH TESTS ON WELDED AND UNWELDED ALUMINUM TUBING

(Test samples 18 inches long; welds left as made with torch, slightly built up; three welded specimens of each size and kind tested; two samples of each size and kind of unwelded tubing tested for comparison.)

Iron Pipe Size Tubing—Inches	Alloy	Tensile Strength Pounds per Square Inch		Elongation Per Cent in Indicated Number of Inches			
		Original	Welded	Original		Welded	
				2	8	2	8
¾	2SO	14,340	13,435*	46.3	34.2	46.8	28.0
1	2SO	12,650	12,975	54.5	36.6	49.8	29.7
1¼	2SO	13,150	13,175	55.3	37.1	53.5	31.8
¾	3SO	16,680	16,065	45.8	27.3	41.3	23.9
1	3SO	14,900	15,010	53.5	35.3	49.7	30.3
1¼	3SO	15,515	15,335*	55.3	34.9	53.0	31.2

NOTE:
* One of three samples failed at weld.

Spot Welding: Aluminum requires no special preparation for spot welding, except that the material must be clean and free from dirt or heavy oxide coating. Such a condition would prevent metal-to-metal contact.

Aluminum or an aluminum alloy of one composition, say 2S or 3S, can be spot welded to an aluminum alloy of a different composition, such as 17S. Sheet may be spot welded to aluminum alloy castings.

Table 15 shows the strength of spot welded joints in 0.0385-

88

. . . look over this page from Chapter 5 and then send 50 cents for the complete book

CHAPTER 5 COVERS: the technique and equipment for heat treating, annealing, cold forming and bend radii; assembling, machining, riveting, bolting and welding—a total of 20 pages.

The 69 pages of Chapters 1 to 4 cover the choice of metal for specific parts; aircraft metallurgy; the mechanical, physical and chemical properties of Alcoa Aluminum and its strong alloys and their use in engines, wings, fuselage, hulls and pontoons.

Chapter 6 is on "Corrosion Prevention." Chapter 7 on "Inspection, Maintenance and Repair." Chapter 8 on the commercial forms, sizes and specifications of the many strong alloys of Alcoa Aluminum for use in aircraft construction.

Every one of these data is the result of our 14 years' work on Alcoa Aluminum and its strong alloys for use in aircraft—work done with the U. S. Bureau of Standards, U. S. Army Air Corps, U. S. Navy Bureau of Aeronautics, The Naval Aircraft Factory, and with airplane manufacturers, operators, pilots and mechanics.

You'll surely want at least one copy of this unique book. Use the coupon. U. S. Postage Stamps accepted. ALUMINUM COMPANY *of* AMERICA; 2482 Oliver Building, PITTSBURGH, PENNSYLVANIA.

HERE'S A COUPON TO MAKE SENDING EASY

NAME_____

STREET & NO._____

CITY_____ STATE_____

NAME OF CO._____ POSITION_____

ALCOA ALUMINUM

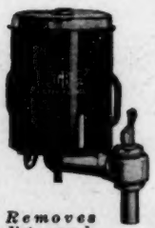
The one metal that flies best

1 MAN INSTEAD OF 4

AND A FASTER FUELING JOB

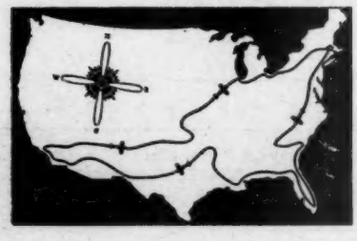
G & B AEROPIT
at Hoover Field
Washington, D. C.

WE SENT A PLANE 16,000 MILES TO PROVE THE NEED FOR OUR FILTER FUNNEL



Removes dirt, sand, lint, rust and sediment. Water in gas instantly revealed in the gauge glass.

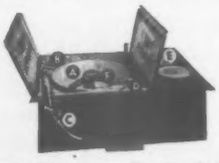
In the past, operators have often preferred to risk a clogged carburetor or fuel line rather than spend the time and trouble for a thorough filtering job. That's why we built our Filter Funnel. That's why we sent our plane all over the country to prove its amazing efficiency. This practical filter has shown a 96% water recovery at 26-gallons-per-minute delivery. The Filter Funnel also takes out all solid impurities. Costs but little and will pay for itself with savings on motor overhauling. Operators and airports should send for special free bulletin.



The G&B Aeropit makes fueling a matter of simple routine. One man does the job—not a crowd. No mobile equipment clutters up your field. Your Aeropit is already on the filling line. Ships don't wait for service either.

Convenient! Long on wear! Economical in operation!—And you get in addition exceptionally fast service. Recently a big transport plane was served 232 gallons of fuel in 9 minutes. Thanks to its "ground level" safety, the Aeropit lessens field hazards. When open, its covers can't touch the wings of a plane. There's nothing to knock over. Fire hazards are reduced.

No wonder you find Aeropits at airports of all types and sizes, here and abroad! Costs you nothing to get complete information.



A *Turntable containing 50 feet of hose.*
B *Pedal actuating pump control switch.*
C *Nozzle (note protective cap on tip).*
D *Hand clean-out pump to keep pit dry.*
E *Dial records unit and total sales.*
F *Ratchet device for recoiling hose.*

GILBERT AND BARKER
MANUFACTURING COMPANY
SPRINGFIELD MASS., U. S. A.
GASOLINE AND OIL FUELING EQUIPMENT

STANDARD THE SIOUX WORLD OVER

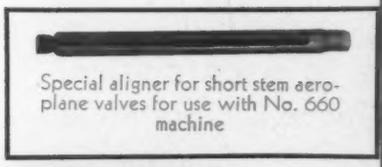
VALVE FACE GRINDING MACHINE

Precision Work on Valve Refacing

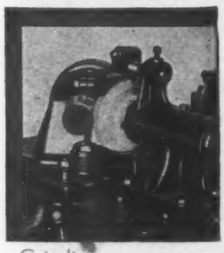
and other valve jobs, is done easier and quicker on the Sioux Valve Face Grinding Machine. It is so accurate, dependable and sturdy because it has these exclusive Sioux features:—

1. **Sioux Roller Chucking System** grips valve stem firmly above worn surface and holds it perfectly centered. Self-aligning, adjustable, positive, accurate.
2. **Automatic Lubrication**—through oil-filtering felt wicks. Keeps out grit and dirt.
3. **Smooth, positive operation,** with fewer parts, through use of SKF self-aligning ball-bearings.
4. **Simple, positive fool-proof method** of engaging and disengaging drive shaft by means of a cam shaft.

Only in the "Sioux" can you get these features and the famous Sioux guarantee. Investigate before you buy.

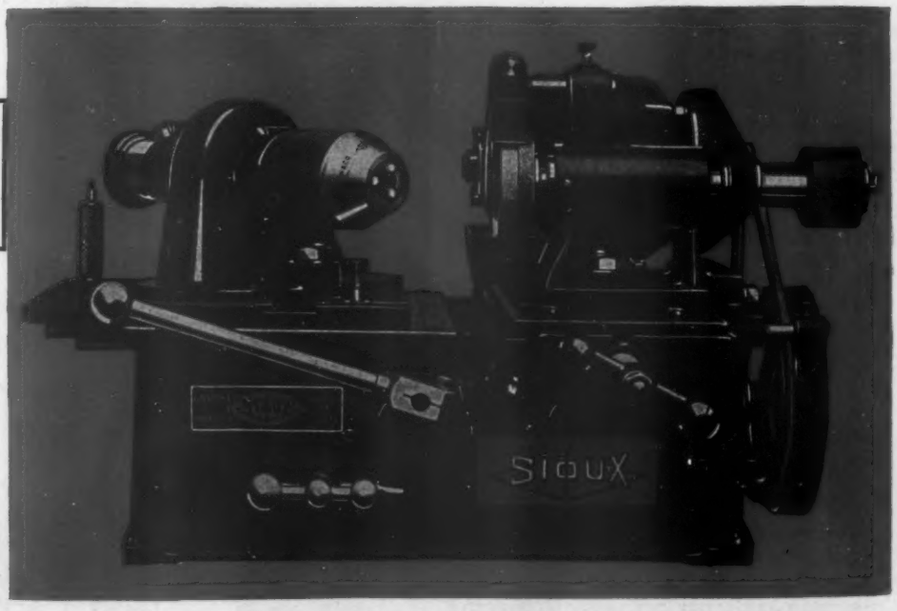


Special aligner for short stem aeroplane valves for use with No. 660 machine



Grinding Valve

Sharpening aeroplane reamer with No. 898 attachment on No. 660 machine.



No. 660 for aeroplane valves of any angle. Handles valve stems of 5/16 in. to 13/16 in. diameter. Complete with ¼ H.P.A.C. motor, extra grinding wheel for large, hard valves, wrenches, etc.

Net $187.50

Your Jobber Sells Them

ALBERTSON & CO. INC.,
SIOUX CITY, IOWA. U.S.A.

FAIR LEAD BUSHINGS *that don't Swell or Shrink*

FORMICA sheets and tubes are made up into fairlead bushings that retain their dimensions under the greatest variety of weather. The material wears as well as cast iron but will not corrode or rot or change in any way that will cause the cables to bind.

Formica cabin lining in wood finishes, solid colors and art moderne finishes is light, extremely durable. It is not injured by moisture or liquids, will not crack or check with age. Some extremely handsome cabs have been built with this material as side walls in the cabin.

FORMICA
CONTROL PULLEYS
These pulleys are made in three types: with bronze bearings impregnated with graphite, ball bearings and roller bearings. These pulleys will operate efficiently in any temperature or climate. They have been extremely popular and are used on a large percentage of the planes now produced.

THE FORMICA
INSULATION COMPANY
4628 Spring Grove Avenue
Cincinnati, Ohio

FORMICA

MORE AIR HOURS

Gulfpride Oil is 100% paraffin base mineral oil refined by the costly Aluminum Chloride method. Exclusive to Gulfpride. Gulfpride Oil exhibits a relatively flat viscosity-temperature curve; high flash and fire values, and low pour tests.

Gulfpride Oil holds its body at high temperatures and resists breaking down under motor heat. It is highly resistant to oxidation and emulsifying action.

Gulfpride Oil is made in five viscosities: 75-100-120-150 and 200 at 210°F, providing a superior lubricant for all types of aircraft motors, under all operating conditions.

Ask for Gulfpride Oil and you'll never be grounded because of oil-caused trouble.

...*There's good reason why*

THIS OIL HOLDS ITS BODY

It's a big mistake to think that "all oils are about alike." Read quick facts here and see why . . . . . .

It's a fact that Gulfpride Oils show remarkably flat viscosity-temperature curves. That is, they hold their body well under extreme high temperature operating conditions, yet do not become objectionably stiff and tacky at low starting temperatures.

Gulfpride Oils permit a smoother, freer running motor. You can see the difference... in higher tachometer readings and in greater power. And sometimes that extra lift comes in handy.

Gulfpride Oils form less than one-fifth as much carbon by Conradson test as the next best Paraffin Base Oil of comparable viscosity on the market. They keep sweet running motors sweet.

Add up these advantages... resistance to heat, flat viscosity curve, freer running motor and low carbon formation... and you see why Gulfpride Oil gives you more *air hours.* Ask for it at the field.

FREE to licensed pilots, licensed mechanics, students of recognized flying schools and those connected with the aviation industry—the Gulf Aviation Atlas. Airways, records and a mass of interesting and valuable facts. Just send post card to Lubricating Department, Gulf Refining Company, General Sales Offices, Pittsburgh, Pa., U. S. A.

Gulfpride Oil

GULF

• GULF REFINING COMPANY •

Hahn Plugs take the IGNITION RACKET out of Radio

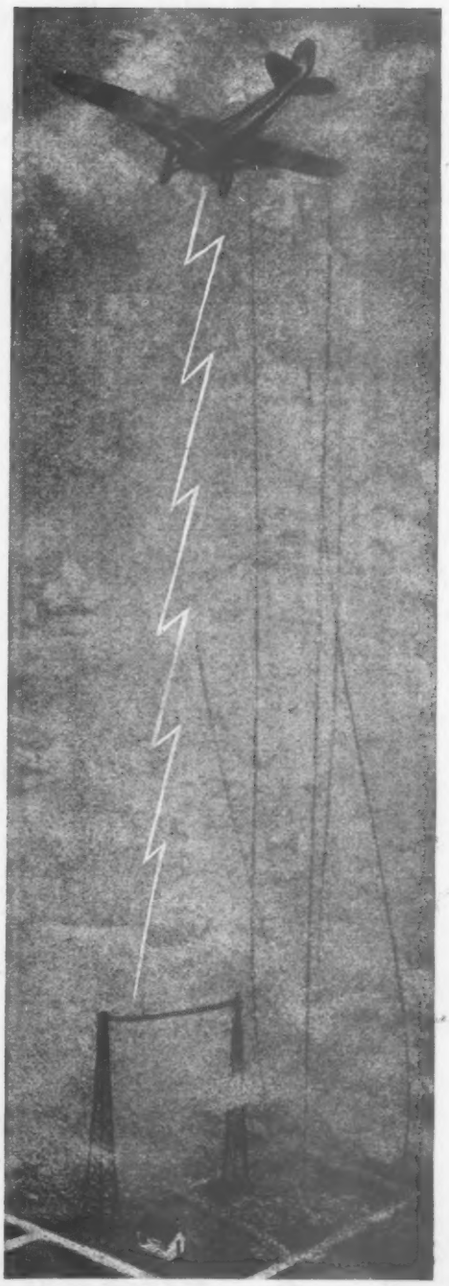
IGNITION RACKET and bad weather make a dangerous combination. When fog blankets the route, or storms are brewing ahead, faultless radio reception becomes a safety necessity.

Hahn Spark Plugs, installed in conjunction with shielded harness and shielded magnetos, eliminate all interference from the ignition system. By silencing Ignition Racket, they make it possible for the pilot to pick up weather broadcasts or beacon signals more easily and at longer range.

At the same time, Hahn Plugs give engine performance that cannot be excelled even with the best unshielded plugs. Hahn Plugs average 500 flying hours in service . . . some have been used for over 800 hours. Considered from the standpoint of cost per hour of flight, they are the lowest in price.

Hahn Plugs are insulated with mica. They are water and spray proof. They do not foul and will not pre-ignite. They can be used with any make of harness.

Our engineers are specialists in radio shielding. They have developed complete shielding installations for the ignition system that are surprisingly low in cost. Why not let them help you with your radio shielding problems?



Investigate the LUX Extinguisher for Aircraft Protection « «

Engine fires hold no terrors for those who fly on Lux protected planes. At the first sign of fire, one quick pull on the Lux control handle releases the Lux Extinguisher and envelops the entire engine in a harmless cloud of fire-smothering carbon dioxide gas. All flames are extinguished instantly.

Over 300 planes are Lux protected. Among them are planes built by Ford, Fokker, Sikorsky, Fairchild, Great Lakes, Keystone and Stearman. Write for details.

HAHN RADIO SHIELDED SPARK PLUG

Walter Kidde & Company, Inc.
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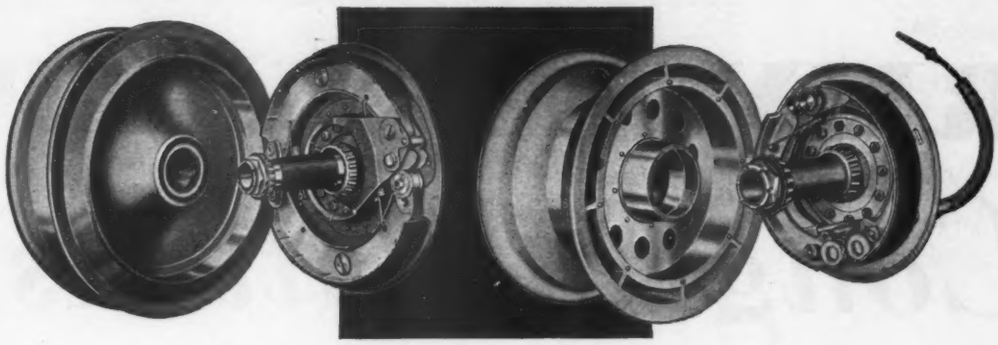

Look to
BENDIX
for Airplane Wheels and Brakes

Bendix engineering developed and perfected the wheel-and-brake for aircraft—which has contributed so vitally to efficiency in ground maneuvers; and to safety.

Bendix now offers the new roller-bearing wheel and brake for still further increased efficiency.

Bendix also offers the Bendix low-pressure wheel, equipped with roller bearings.

All Bendix' broad experience in brakes—automobile and aviation—is built into these new units.

Built to U. S. Army Air Corps, U. S. Navy, S. A. E., and Tire and Rim Association Standards.

BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Subsidiary of Bendix Aviation Corporation)

BENDIX 4 BRAKES
FOR SAFETY

FULLY PROTECTED BY PATENTS AND APPLICATIONS IN U. S. AND ABROAD

Air Mail Saves Time

To the
ARMY AIR CORPS
Congratulations

From the furrows of their fields men looked aloft in wonder; in country road and city street, on the roofs of towering sky-scrapers, millions watched with soaring pride as your great armada of the air swept by on thundering wings.

With equal pride and full realization of your accomplishment, we whose lives are devoted to aviation take this opportunity of offering our congratulations on the success of the 1931 Army Air Corps Exercises.

The executive, administrative and flying personnel and the ground organization showed a peak of efficiency, and the equipment a mechanical perfection, that mark significant progress since the World War.

With congress and the people of this country we rejoice in this fitting climax to the five-year army program of the aviation branch of our national defense.

FOKKER AIRCRAFT CORPORATION OF AMERICA

Division of General Aviation Corporation

GENERAL MOTORS BUILDING, NEW YORK

"Opened instantly from 75 ft. altitude —wonderful Safety demonstration"

Writes
Woodruff De Silva
Assistant
Director of Airports
Los Angeles
Calif.

Actual Photograph
by
ACME—P & E

SWITLIK SAFETY CHUTES

The above excerpt is from one of many letters we have received from prominent Aviation Officials, praising the Remarkable Performance of the SWITLIK SAFETY CHUTE. This parachute is the lightest, most compact and efficient parachute in the world today. It functions under all conditions due to its refined engineering. The snug-fitting harness is a revelation to wear, made of soft pure purged linen and held in a vest shape by the patented back pad and harness combination. SWITLIK is standard equipment for the foremost operating lines and flying schools everywhere.

White Silk
$300
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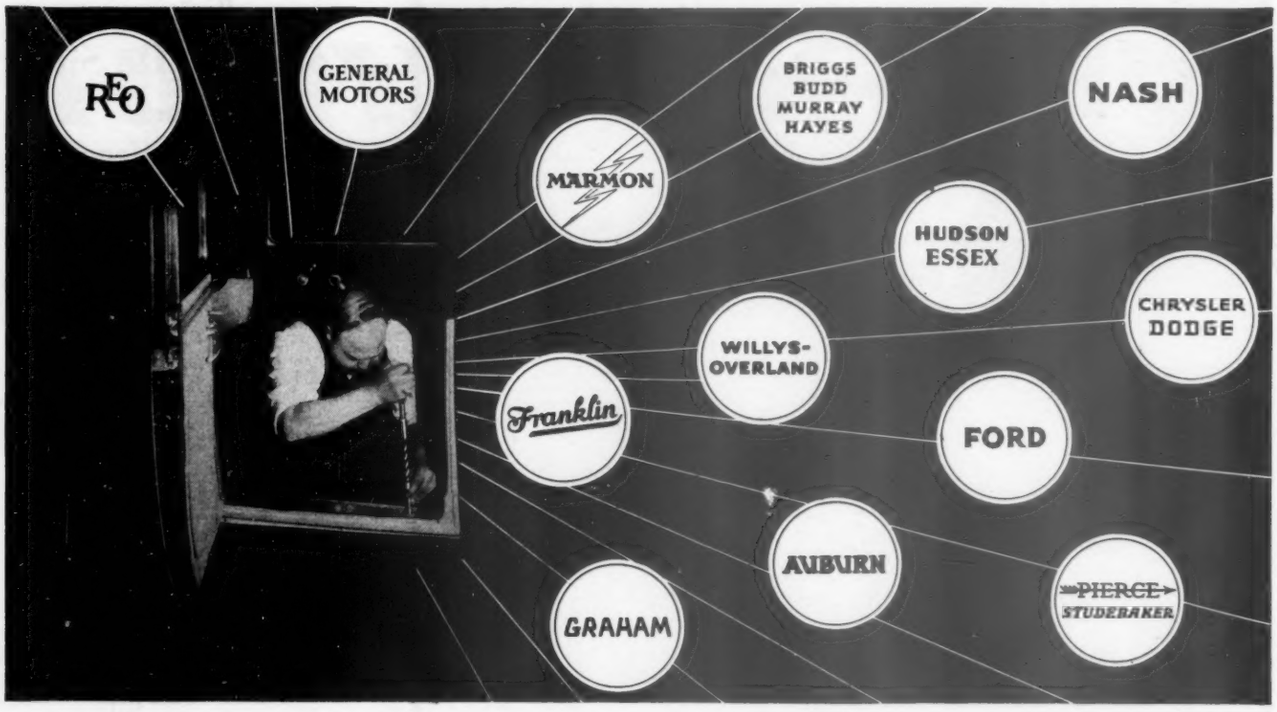
SWITLIK PARACHUTE & EQUIPMENT CO.

BROAD & DYE STREETS TRENTON, N. J.

WESTERN MANAGER — BERT WHITE — 1223 AIRWAY — GRAND CENTRAL AIR TERMINAL — GLENDALE, CALIF.

THE AUTOMOTIVE INDUSTRY MUST KNOW THE CHEAPEST WAY TO ASSEMBLE SECURELY



Self-tapping Screws are used on 85% of the industry's production

Millions of fastenings are made in a year's production of a car or body. The manufacturer cannot afford to pick fastening devices in a haphazard manner. He must know to the fraction of a cent which fastening device is the most economical to use . . . which one offers the easiest and quickest way of making metal assemblies.

It is significant that Self-tapping Screws are used for metal assembly on 85 per cent of the automotive industry's production. The industry's saving through the use of these unique Screws is enormous. One body builder alone saved over $150,000 in a single year by using Self-tapping Screws in place of machine screws and other devices for making fastenings to sheet metal. He gained more secure assemblies, too. For scientific tests show that fastenings made with Self-tapping Screws hold better than either machine screws or bolts and nuts under tension, shear and vibration stresses.

Whether you make automobile bodies or corn poppers... if your product requires metal assembly you may be able to do it cheaper and better with Self-tapping Screws. It costs nothing to find out. Our Assembly Engineers will tell you, if you attach a description of your assemblies to the coupon which brings two free booklets on Economy and Security of making fastenings with Self-tapping Screws.

Hardened Self-tapping Sheet Metal Screws

For joining and making fastenings to sheet metal up to six gauge; also aluminum, die castings, Bakelite, etc. Simply turn Screw into drilled, pierced or molded hole. It forms a thread in the material as it is turned in. Can be removed and replaced.

Type "U"—Hardened Metallic Drive Screws

This type of Self-tapping Screw is used for making permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, Durez, etc. Just hammer the Screw into a drilled or molded hole. It forms a thread in the material as it is driven.

PARKER-KALON *Hardened* Self-tapping Screws

PAT. IN U. S. AND FOREIGN COUNTRIES

PARKER-KALON CORPORATION, Dept. M., 192-200 Varick Street, New York, N. Y.

Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co.----------

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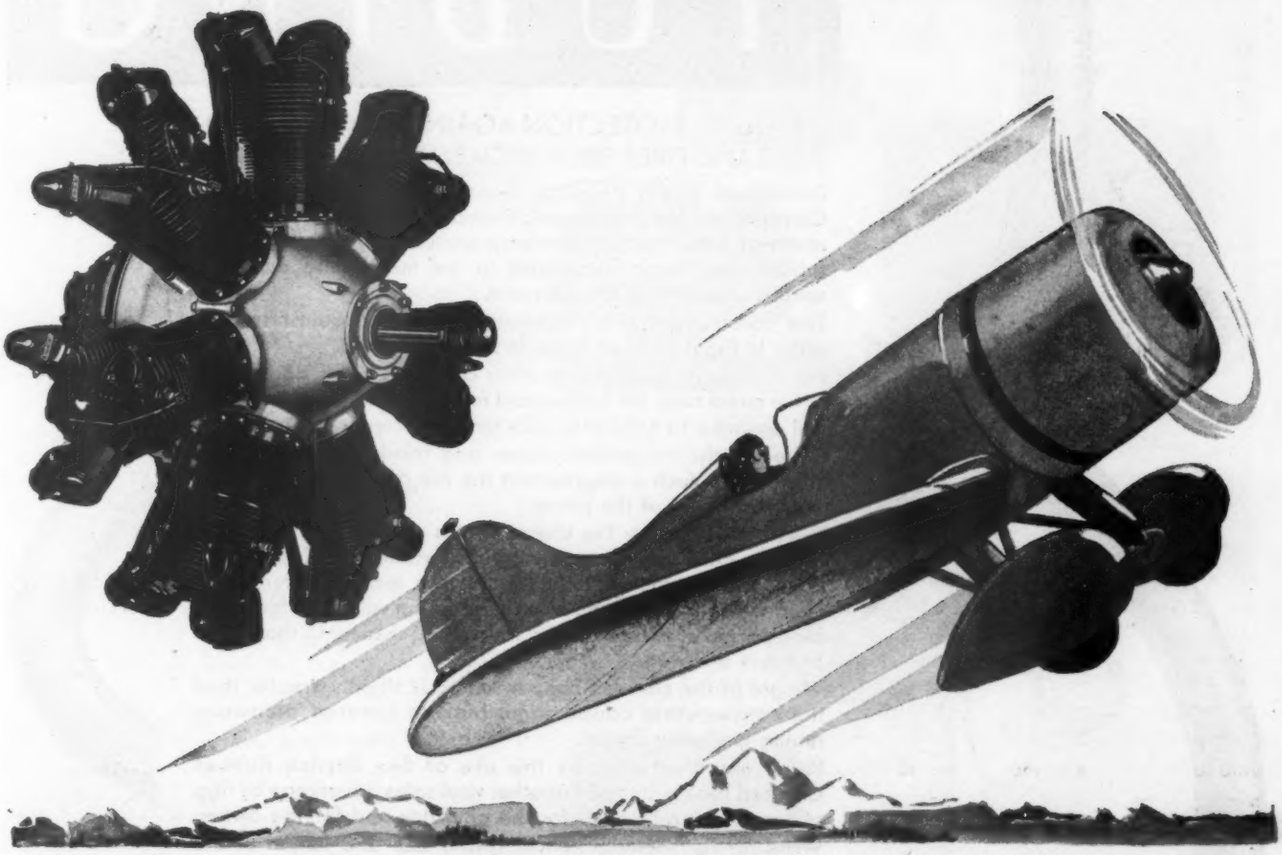
Continental

RED SEAL

ALWAYS THE MARK OF ENGINE QUALITY

NOW A GREAT NAME IN AVIATION



For 30 years the Continental Red Seal has identified engineering skill and dependability in gasoline engines. Continental—founded upon a sound administrative and financial structure—now makes the Red Seal the symbol of permanence and performance in aviation. ¶ Continental—its men—its facilities and its resources—guarantee to aviation a dependable and permanent source of supply.

CONTINENTAL AIRCRAFT ENGINE COMPANY

General Office and Factory, Detroit, Michigan

Continental

SKY SERVICE

ANNOUNCING SKY SERVICE

Rubber Covered TUBING

ABSOLUTE PROTECTION AGAINST FORCED LANDINGS AND FIRES FROM BROKEN FUEL OR OIL LINES

Developed by the Research Department of Sky Specialties Corporation, Sky Service vulcanized rubber covered tubing is made of either copper or aluminum tubing with oil resisting rubber and fabric vulcanized to the metal tube and with special connections on each end.

This construction gives absolute insurance against trouble while in flight through leaks in fuel or oil lines.

For if through vibration, or other causes, a crack does occur in the metal tube, the rubber and fabric surrounding the tubing will continue to hold until such time as a repair can be made.

Moreover the vulcanized rubber and fabric cover minimizes vibration to such a degree that the life of the tubing will be practically that of the plane.

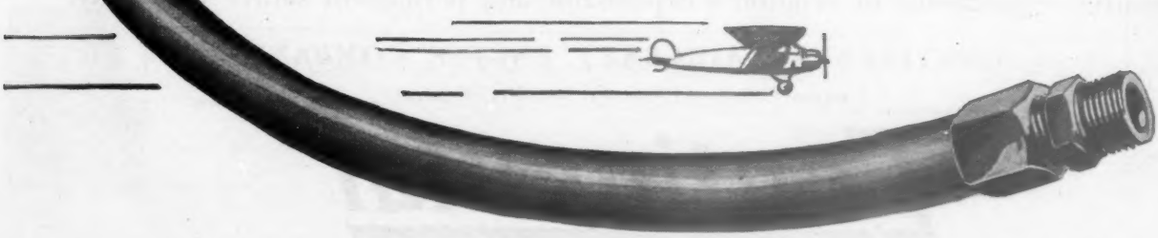
Tests conducted by the United States Army at Wright Field, Dayton, Ohio, prove that whereas ordinary tubing breaks down in 15 minutes under the severe test conditions they impose, Sky Service rubber covered tubing will stand the strain for a period of several weeks, which is equivalent to thousands of hours of flying.

Weight of the covered copper tubing is slightly greater than the conventional copper line, but the covered aluminum tubing is slightly lighter.

Plane manufacturers, by the use of Sky Service Rubber Covered Tubing can add another vital sales advantage by thus eliminating fire hazards for the operator and for the owner.

Write for further information, giving size and length of the tube you are now using and the size of pipe thread connection at each end.

SKY SPECIALTIES CORPORATION
3651 HART AVENUE - DETROIT, MICHIGAN



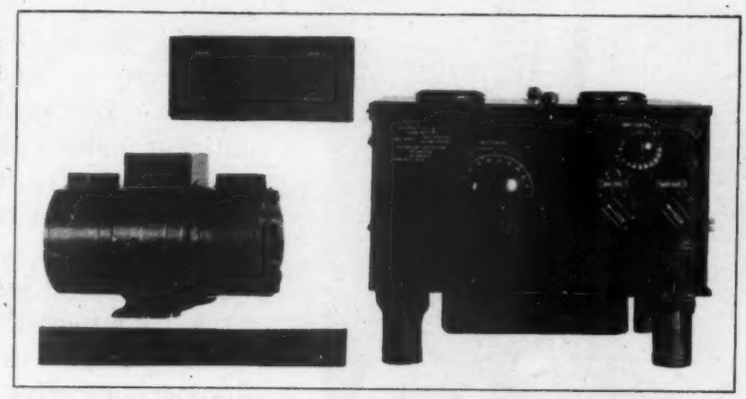
TRAVEL BY AIR · U.S. AIRWAYS · AERONAUTICAL CHAMBER OF COMMERCE

LIGHTWEIGHT

Radiophone equipment

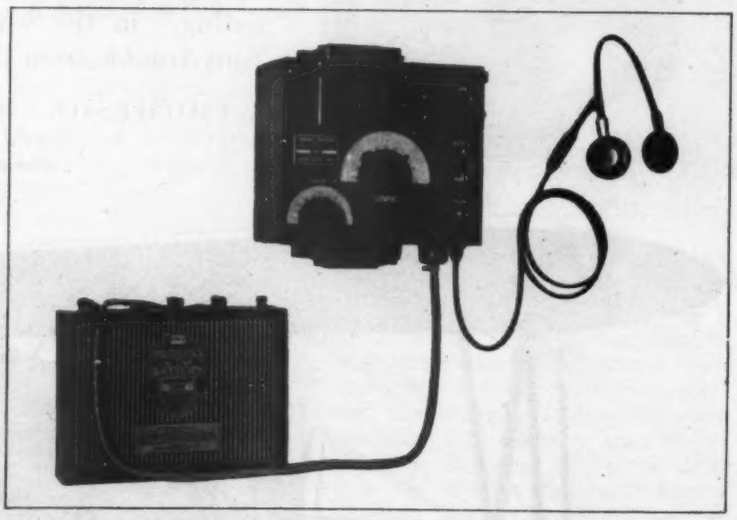
This is the type of radio equipment used on all Eastern Air Transport passenger carrying planes. RCA recommends it for all planes which could not formerly carry radiophone equipment because of space or weight limitations. It fills the communication requirements of the itinerant flyer as well as the Transport Operator.

The Type B transmitter may be mounted in any part of the plane where approximately one cubic foot of space is available. Its use insures long range, dependable communications by either radio telephone or telegraph on itinerant or transport frequencies.



Type B Radio Telephone and Telegraph Transmitter. Weight complete—34 pounds. Priced at $1,000.00 f.o.b., New York.

The Type A Receiver is a thin model designed for use in the cockpit of any type of plane. It covers the Department of Commerce beacon-weather and Transport Communication bands as well as the entertainment broadcast bands.



Type A Receiver. Priced at $325.00 with one coil set f.o.b., New York. Weight complete with accessories as shown—20 pounds.

Please address inquiries to the service office nearest to you:

RADIOMARINE CORPORATION OF AMERICA

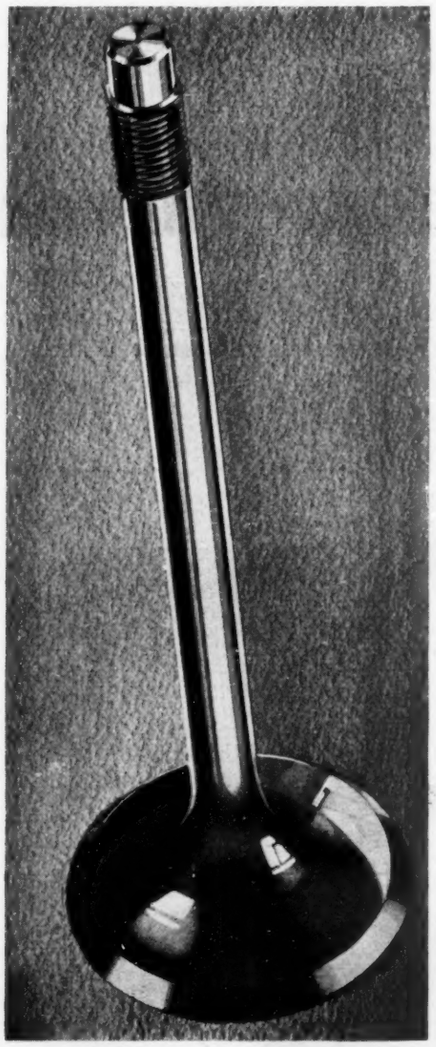
(A Radio Corporation of America Subsidiary)

66 Broad Street, New York City.

1599 St. Clair Avenue, Cleveland, Ohio.
16 First Street, San Francisco, Calif.
519-516 St. Peter Street, New Orleans, La.
227 Fries Avenue, Wilmington, Calif.

Radiomarine service stations also at Chicago, Boston, Savannah, Duluth, Buffalo, Baltimore, Norfolk, Philadelphia, Galveston and Seattle.

FAMOUS FLIGHTS WITH THOMPSON VALVES



When *Maughan*

RACED THE SUN ACROSS THE CONTINENT

Few flights have stirred the imaginations of their day like the epic "Dawn to Dusk" achievement of June 23, 1924, which made Lt. Russell L. Maughan of the United States Army the first man to flash across the North American continent under a single sun. Flying an army pursuit plane powered with a Curtiss D-12 engine, he took off from New York at daybreak, landing at Crissy Field, San Francisco, just as darkness was settling over the throng that had gathered to greet him. At his destination, as at every one of the five refueling stops, his motor was reported "working without a flaw." One reason for this was the fact that the all-important valves were Thompsons—"definitely eliminating," in the words of Curtiss' chief motor engineer, "any trouble from this source."

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

This advertisement is one of a series recalling historic flights in which Thompson Valves were used.

Thompson Valves

WORLD'S *Endurance* RECORD

ONCE MORE WON BY BELLANCA

84 hours 33 minutes

Walter Lees and Frederic Brossy established a new endurance record (without refueling), 84 hours and 33 minutes, from May 25th to 28th, at Jacksonville, Florida, in a Bellanca Pacemaker powered with the Packard-Diesel 225 h.p. Engine.

Internationally this is regarded as the most important airplane record—the only record that provides an indisputable standard of load-carrying capacity. Beyond all challenge it proves the reliability of both plane and power plant.

The enormous load taken off by the Bellanca monoplane was 6,715 pounds gross weight. The actual useful load at the start was 4,365 pounds. This included the two pilots, supplies, and 531 gallons (almost 17 barrels) of fuel and motor oil—equivalent to the weight of not less than 25 people.

Had the flight been made in a straight line at normal cruising speed and fuel consumption, it would have covered a non-stop distance of 6,580 miles, or approximately the distance from Florida to Japan!

These stupendous facts proclaim the supremacy of Bellanca aircraft and the almost magical development of the Diesel type engine by Packard. It is significant that the Packard-Diesel Engine gave its greatest demonstration of economy and dependability in a Bellanca plane. For efficiency, safety and lifting capacity, combined with speed, the Bellanca holds its leadership year after year. Among the many reliability and efficiency records surpassed in Bellancas, this is the third time the World's Endurance Record has been captured by planes "built as only Bellanca can build."

Walter Lees and Frederic Brossy, Packard Pilots, with their Packard-Bellanca

The Packard-Diesel Aircraft Engine

Many inquiries are being received for the Packard-Diesel-Bellanca combination for long-distance flights.

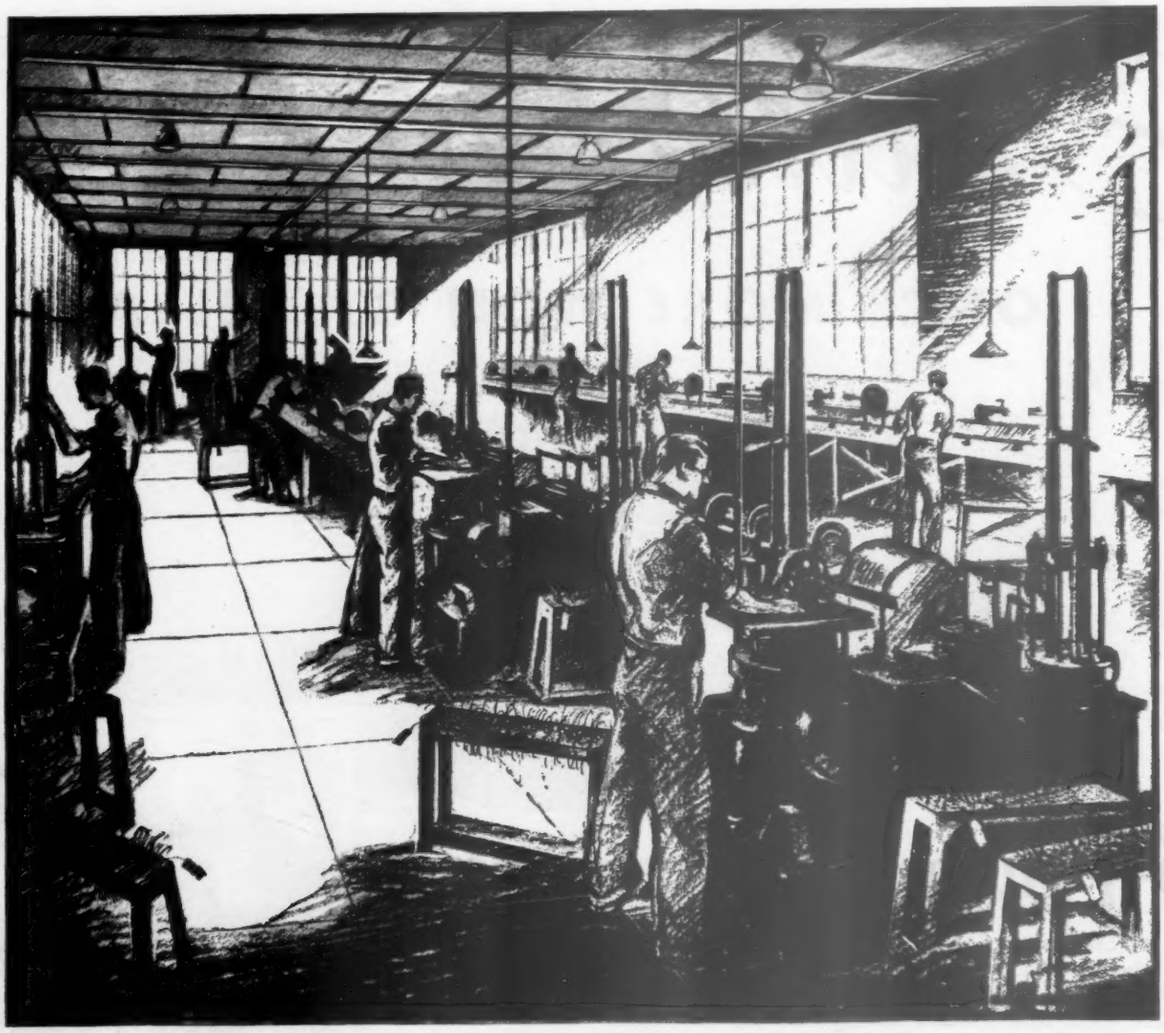
ALL BELLANCA AIRCRAFT ARE MANUFACTURED UNDER DEPARTMENT OF COMMERCE APPROVED TYPE CERTIFICATES

BELLANCA AIRCRAFT CORPORATION

New Castle, Delaware — Chrysler Building, New York

Bellanca Aircraft of Canada, Ltd., Montreal

BELLANCA



No. 10 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Aircraft Products"

Nothing is left to Chance

NOT even a single wire in a reel or coil of any Roebling Wire Aircraft Product is an "unknown quantity." Even years after shipment, its complete manufacturing history is retained in the Roebling files. At any time, Roebling can trace right back to the very heat of steel from which the wire was made.

In the testing laboratories, a typical view of which is shown above, *every* bundle of wire is painstakingly tested. Gauging, tension, torsion and elongation tests are made on samples of wire clipped from each bundle. No wire which does not meet the exacting Roebling standards is used for Roebling Aircraft Wire, Strand and Cord. For example, when testing the wire, only that which attains the very highest rating is accepted.

When you order a reel or coil of Roebling you get more than merely so many feet of wire, strand or cord. You get predetermined quality, known stamina, safety —of the highest degree.

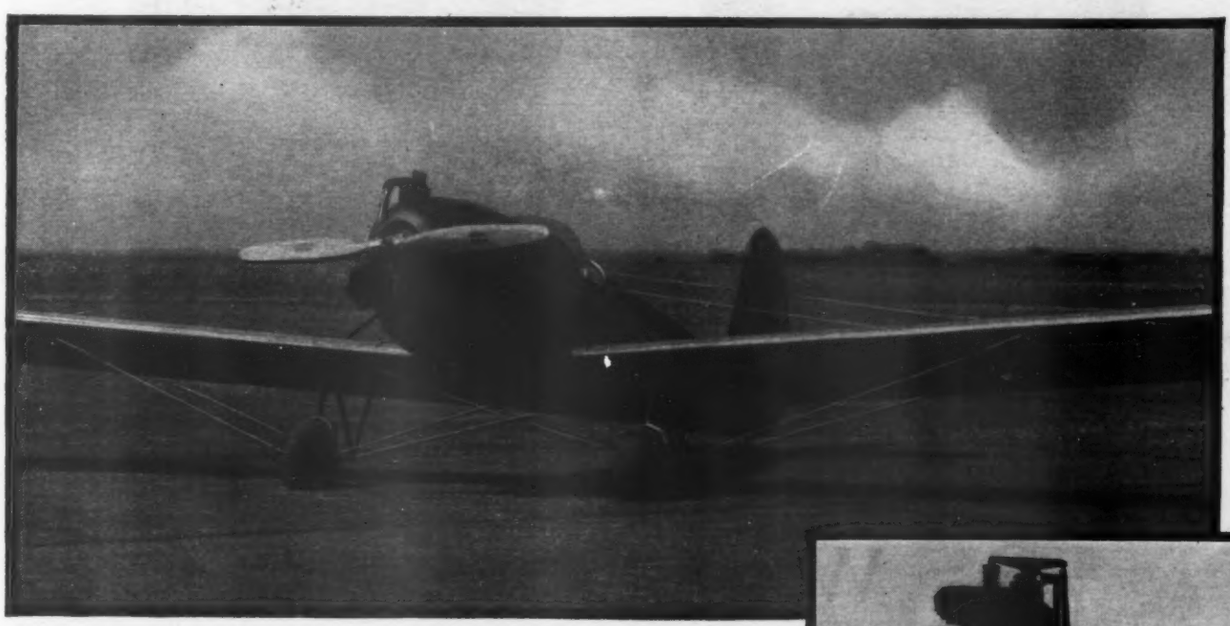
JOHN A. ROEBLING'S SONS COMPANY
WIRE . . . WIRE ROPE . . . WELDING WIRE . . . FLAT WIRE
COPPER *and* INSULATED WIRES AND CABLES
WIRE CLOTH *and* WIRE NETTING . . . *Export Dept., New York*
TRENTON, N. J. *Branches in Principal Cities*

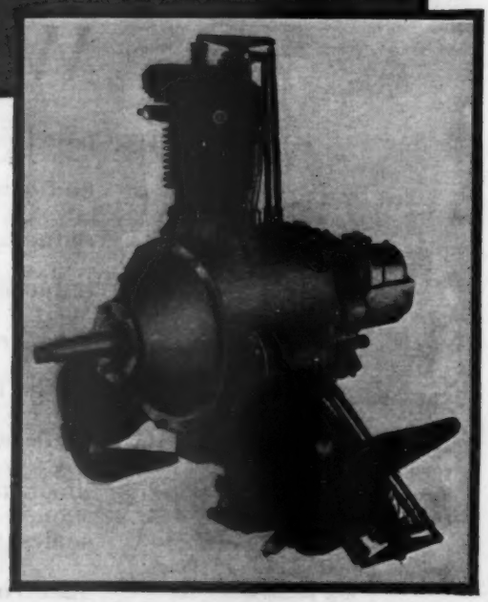
ROEBLING WIRE AIRCRAFT PRODUCTS

Smooth . . .
Dependable Power
for the Smaller Plane

the JACOBS L3

RATED 55 H. P.
AT 2100 R P M





THE NEW
SPARTAN

An entirely new type for the Sportsman Pilot, in a price class you can afford . . . outstanding performance, well over 90 M. P. H. full out, cruising at 83 miles . . . 25 miles to the gallon . . . made possible by its JACOBS L3 engine . . . as smooth and absolutely dependable as an engine can be made.

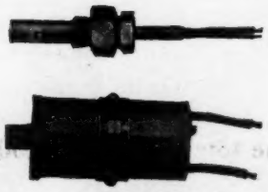
JACOBS AIRCRAFT ENGINE CO., CENTRAL AIRPORT, CAMDEN, N. J.

JACOBS AIRCRAFT ENGINES

TELLING TEMPERATURE AND PRESSURE BY WIRE

These ELECTRIC INDICATORS

Simplify Installation and Reduce Weight



The temperature and pressure elements of General Electric indicators consist of resistances that are especially calibrated and sealed in small metal cartridges for attachment to standard fittings.

WITH General Electric pressure and temperature indicators, the only connection between the engine and instrument panel is a small-size electric wire. This takes the place of tubing and other mechanical connections, simplifying the installation and reducing the cost. Furthermore, it makes possible a substantial reduction in weight, especially where engine-oil pressure, oil temperature, and fuel pressure are brought from outboard installations to the instrument panel. All General Electric aircraft instruments are available in shock-absorbing cases of standard dimensions for flush mounting. Jeweled bearings and luminous pointers and scales are used. Let us send you complete information. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

AËRONAUTIC EQUIPMENT

700-11

SPECIALISTS IN NEW YORK, WASHINGTON, DAYTON, AND LOS ANGELES

SIX BILLION HORSEPOWER-HOURS

Photo by U. S. Army Air Corps, from Wide World photos

This view of a detachment of Keystone Bombers was snapped at Bear Mountain, above the Hudson River, while the planes were en route for their second visit to New York during the maneuvers

PRODUCED BY WASP AND HORNET ENGINES DURING THE WORLD'S GREATEST AIR MANEUVERS

The recent air maneuvers brought home even to the most casual observer the remarkable efficiency of the Army Air Corps. Within a period of fifteen days, some 3,500,000 plane-miles were flown—a total of 31,500 hours in the air. Over 1,500 men were transported. This record is particularly remarkable when it is realized that the planes were operating from widely scattered bases and under all sorts of weather conditions.

To us, in the business of building aircraft engines, the power back of this huge demonstration was of absorbing interest. Of the 765 engines powering the planes, 408, or 53% were of Pratt & Whitney manufacture. In terms of power, Wasp & Hornet engines produced over 198,000 h. p., or about 56% of the total—some 350,500 h. p. During the maneuvers Pratt & Whitney engines delivered, without faltering, more than 6,200,000,000 horsepower-hours.

Another demonstration of faith in Pratt & Whitney engines. And of Pratt & Whitney dependability. The same dependability that leads 90 per cent of the regularly scheduled air transport lines of this country to use Wasp & Hornet engines.

Wasp* & Hornet* *Engines*

* Registered Trade-Mark

THE PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corp.

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

Do you know that . . .

each month our subscription department receives more than 150 requests for "Back" issues of AVIATION?

◆ ◆ ◆

If we printed extra copies of our monthly issues, we would be glad to comply with these requests, but unfortunately we have no way of knowing in advance just how many of our newsstand readers will "miss" an issue.

◆ ◆ ◆

But We Do Know **— that each of these requests indicates a reader has "missed" just the issue he could make valued use of.**

Insure your receiving AVIATION *regularly by filling in the coupon below, today . . . .*

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New York City

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Here is my check for $3.00. Send me Aviation for one full year.

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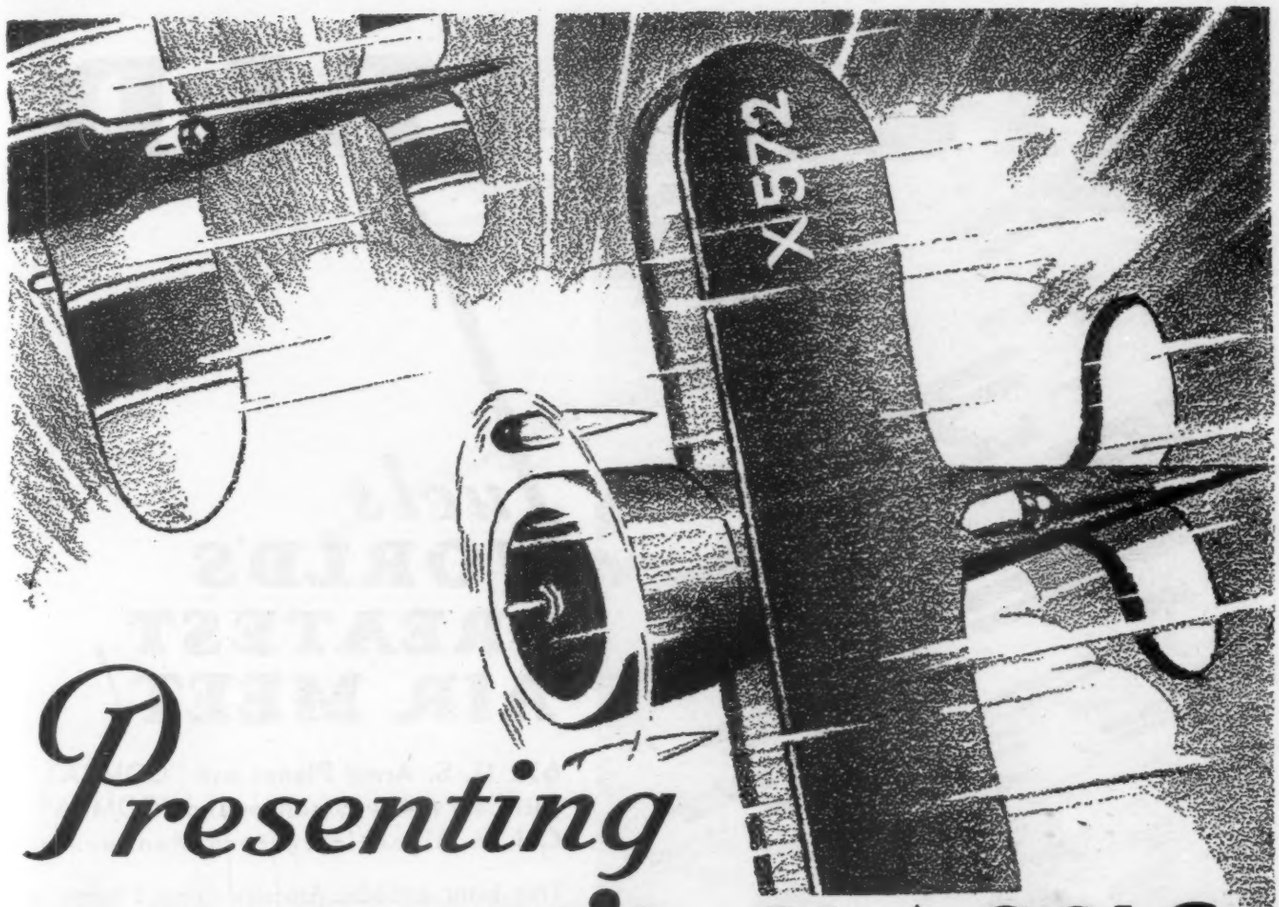


Presenting AVIATION'S CLASSIC *for* 1931

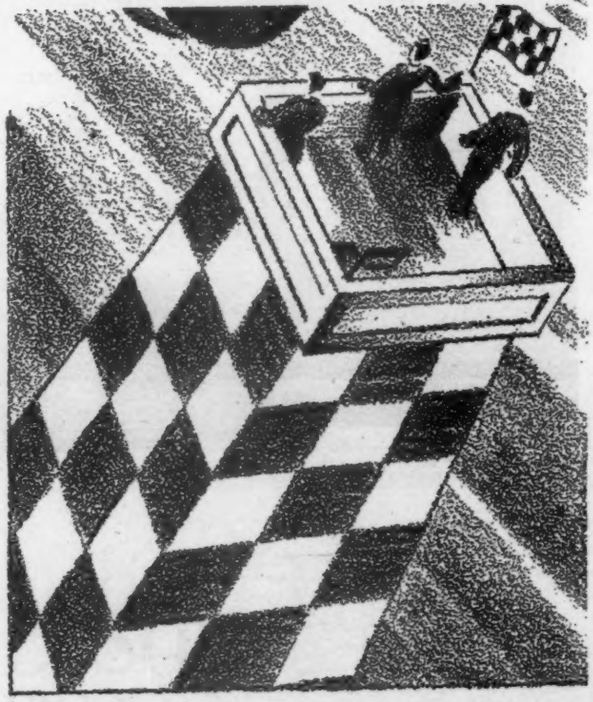
AUG. 29 *to* SEPT. 7

THIS YEAR, more than ever before, the National Air Races will eclipse in magnitude and magnificence any like enterprise of the past decade. The free-for-all events in all acknowledged cubic inch classifications will encourage new competition, while the speed dashes over a one-mile straight-away course will create keen rivalry and establish new American records.

All A. T. C. and Group II derbies will be concentrated into one major handicap derby, making it the largest competitive mass flight in the history of aeronautics. It will be divided into two classifications; for men and women pilots, and be open to ships of every type and power classification. The On-To Derby will be a free-for-all dash from the west coast to Cleveland, non-stop or with landings, elapsed time governing the awards.

Blimp, autogiro and amphibian novelty races, glider flights, parachute jumping contests, aerobatics and other innovations, inclusive of nightly flying exhibitions, will complete the colorful program. Cash prizes totalling $100,000 plus valuable trophies will be awarded.

A hearty welcome is extended you to become a part of this outstanding air classic. Complete details on request. Write Clifford W. Henderson, *Managing Director.*



NATIONAL AIR RACES

Hotel Cleveland, *Executive Headquarters*

CLEVELAND ' ' ' OHIO

RICHFIELD

fuels

WORLD'S GREATEST AIR MEET!

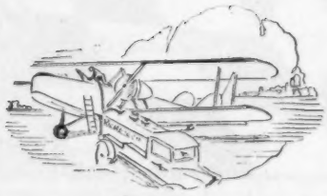
672 U. S. Army Planes use "COMBAT," Richfield's New Gasoline, and "COMBAT" Oil in Gigantic Eastern Maneuvers.

This giant armada...America's proud boast of the air..was serviced by the Richfield Oil Company without a mishap, without the slightest delay. 46 Richfield gasoline trucks and 5 Richfield oil trucks were assigned to the job. More than 3,000,000 miles were covered by these planes during the two weeks maneuvers...without a single serious accident.

Never before has an air meet been carried on... on such a grand scale...or been so signally successful. Great credit for the success of the maneuvers is due to Major-General James E. Fechet, Brigadier-General Benjamin D. Foulois and Colonel H. H. Arnold.

The same high type of service, the same outstanding quality of "COMBAT" products which Richfield provided to the army, are available to you at all times. Get acquainted with this service, these products...at important airports both east and west of the Mississippi!

Remember the new name . . . "COMBAT."



COMBAT
Richfield's Aviation
GASOLINE

RICHFIELD OIL COMPANY ◆ LOS ANGELES ◆ NEW YORK CITY

MACHINES *can't do this* *Alone*

MINUS the guidance of skilled operators, the most accurate machines could never produce accurate engine parts.

Hands may make them work, but the experienced, intelligently applied brains of experts must guide *both* hands and machine.

That is why more and more aircraft engine manufacturers who are honestly striving for perfection in their products have turned to the shops of Govro-Nelson, where they find:

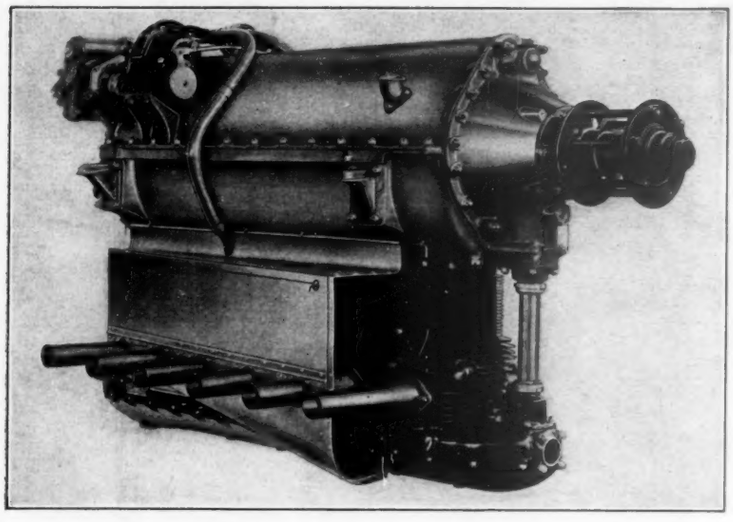
Not only the most efficient, accurate, production machines, the most precise testing equipment; but a corps of workmen, skilled through years of service to the aviation industry, and with a fine regard for the prized reputation for accuracy in the machining of aircraft engine parts that only craftsmen could build.

THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

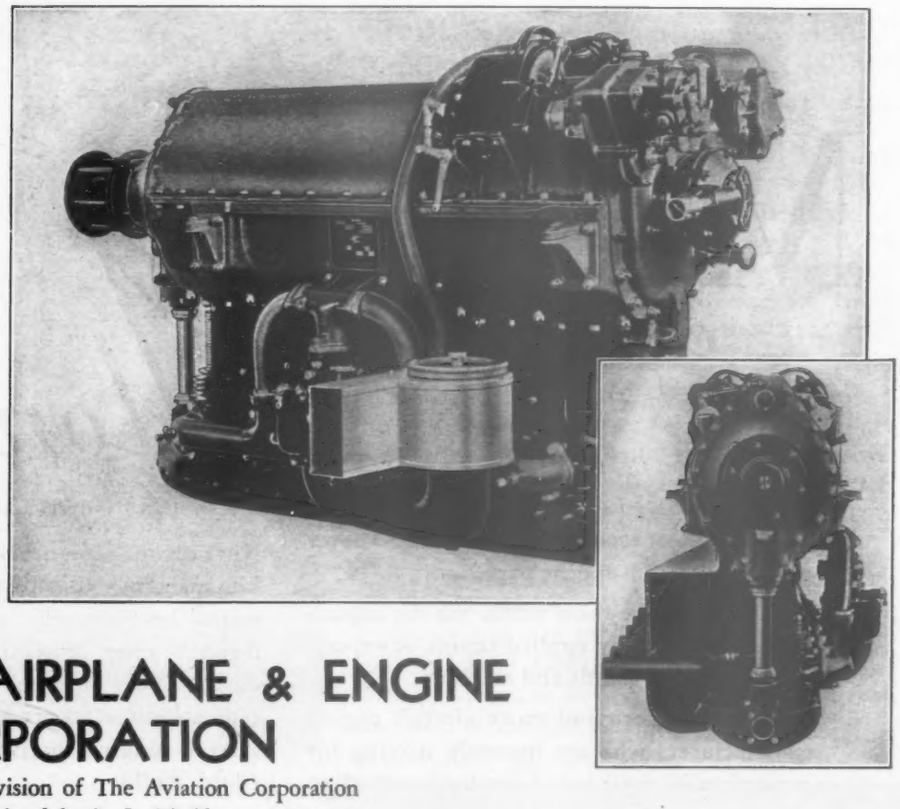
The RANGER 6-390
AIRPLANE ENGINE



Any way you look at it, it's a fine engine!

The many advantages offered to the discriminating user by this ultra-modern aircraft engine are fully described in a folder which will be sent upon request.

Address inquiries to



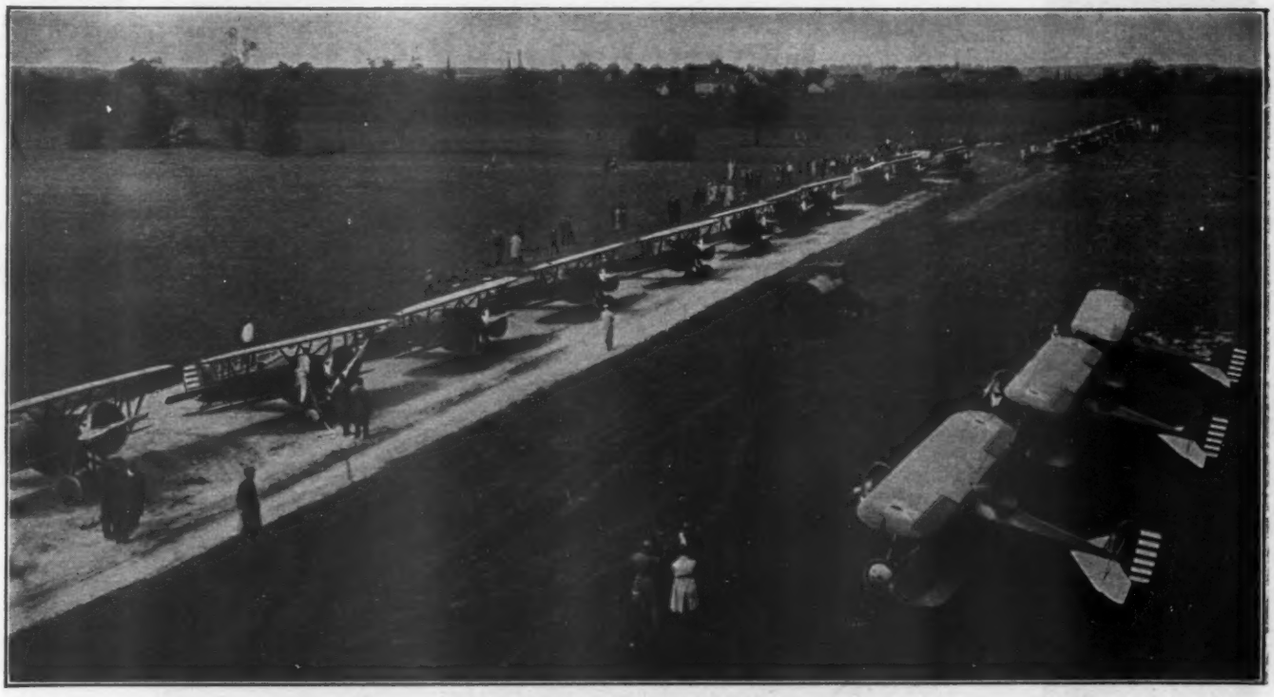
AMERICAN AIRPLANE & ENGINE CORPORATION

Manufacturing Division of The Aviation Corporation
Farmingdale, L. I., N. Y.

Manufacturers of the PILGRIM 10 place Model 100 A Transport Airplane

We have for sale several slightly used factory demonstrators in all types of FAIRCHILD open cockpit biplanes and closed cabin monoplanes, in excellent condition at most attractive prices.

FULL INFORMATION ON REQUEST



Pursuit Ships Re-Fueling at Rochester

Stromberg-Carlson Aircraft Receivers Take Part in Army Maneuvers . . . .

Model D Aircraft Receiver equipped with Eveready Raytheon 4-Pillar Tubes and powered by Eveready Dry Batteries. Over-all Dimensions of Receiver and Mounting Base: 16½ x 9½ x 9¼ inches. Weight: 18 lbs.

Stromberg-Carlson Aircraft Receivers are licensed under A. T. and T. Co., R. C. A., R. F. L. and Aircraft Radio Corporation patents.

FRESHLY VARNISHED wings and striped rudders, gaily glistening in the sunlight..... Craft of every description from trim and fleet pursuits to giant bombers..... America will long remember the glorious spectacle of the recent army air maneuvers!

And for Stromberg-Carlson, the recollection of its own part in this spectacular demonstration, will be a source of lasting and justifiable pride. Ships equipped with the new Model D Aircraft Receiver, ably demonstrated its value as a *safety* aid to flying in communication work, direction finding and in the co-ordination of groups in close formation. It was a supreme test in which Stromberg-Carlson came off with flying colors.

Everyone interested in aviation should know the simplicity of this receiver's construction, its ease of operation and other details proving its indispensabilty to modern air travel. Interesting descriptive brochure sent free upon request.

STROMBERG-CARLSON TELEPHONE MFG. CO., ROCHESTER, N. Y.

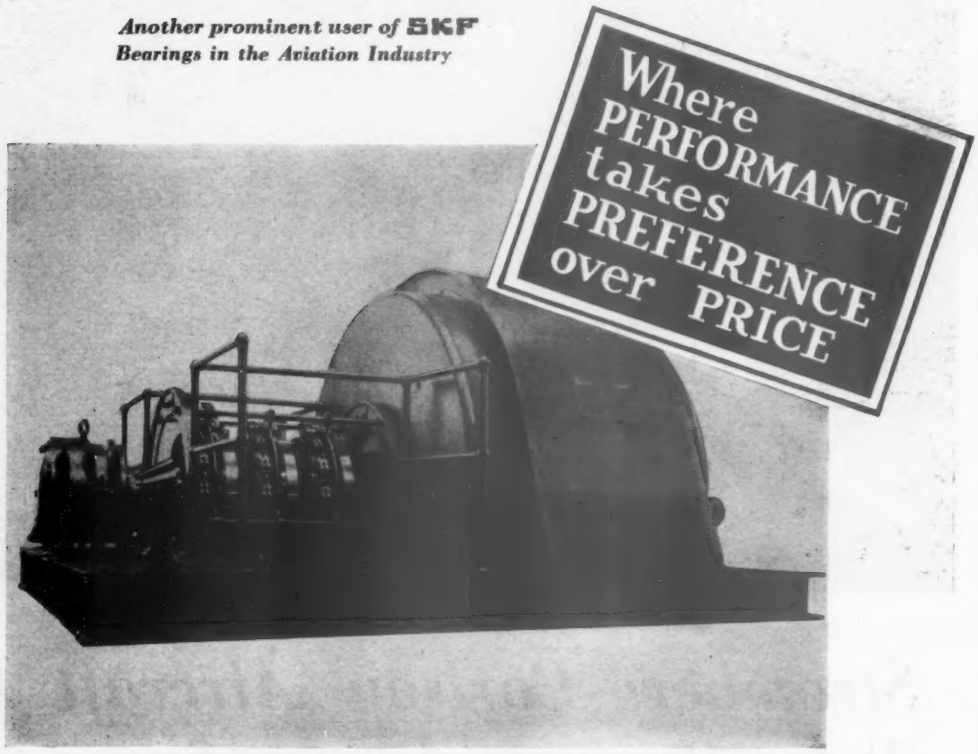
Address all inquiries to our sales representative, Aircraft Radio Corporation, Boonton, N. J.

Stromberg-Carlson

MAKERS OF VOICE TRANSMISSION AND VOICE RECEPTION APPARATUS FOR MORE THAN THIRTY-FIVE YEARS

GENERAL ELECTRIC COMPANY

Another prominent user of SKF Bearings in the Aviation Industry



4000 H. P. WIND TUNNEL MOTORS BANK ON SKF

AIR rushing in a 100-mile gale through the new million dollar full scale wind tunnel at Langley Field determines the forces acting upon an airplane in flight. To create this tempest, gigantic fans are driven by two of the largest anti-friction bearing induction motors in the world... and both are SKF equipped. Built by the General Electric Company, they have a rating of 4,000 H. P. at 300 R. P. M. The shaft is nearly 12" in diameter.

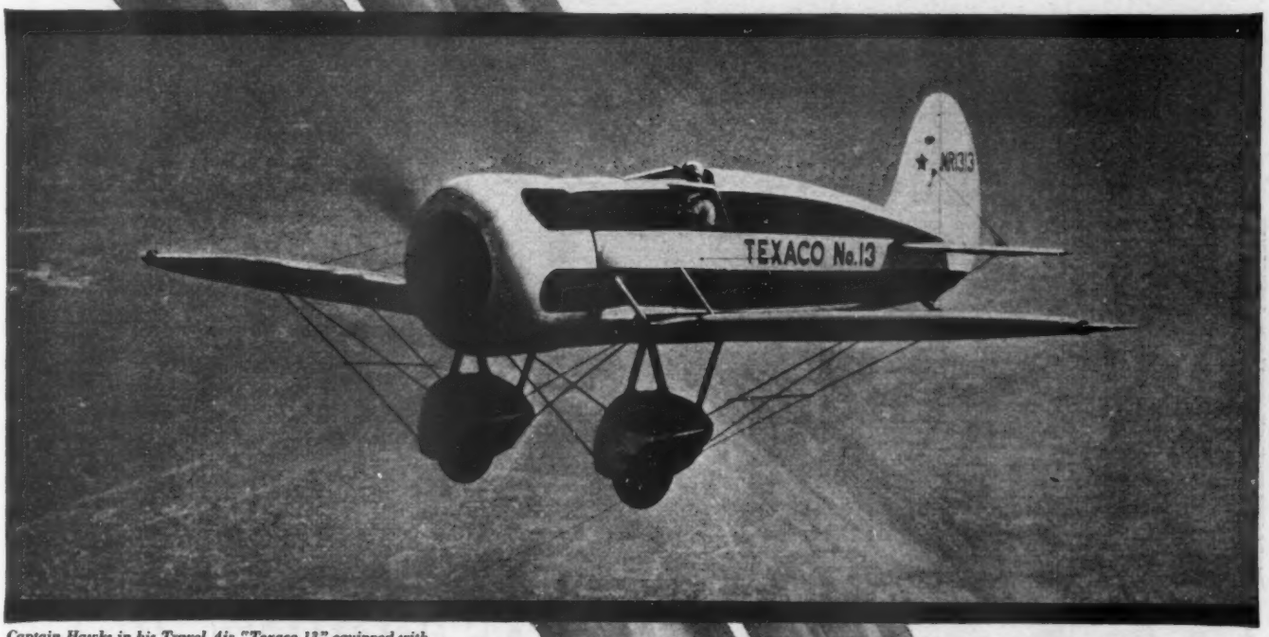
Performance...was the basis on which SKF Ball and Roller Bearings were chosen for these electrical giants by the National Advisory Committee for Aeronautics. And SKF Bearings have definitely proven that there can be no compromise with this all-important factor of performance if aviation equipment and electrical machinery is to maintain a high standard of efficiency, not only under normal conditions but even more so when the unusual arises.

SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.

SKF

2656-S

BG WITH CAPTAIN HAWKS . . . . . "OVER THERE"

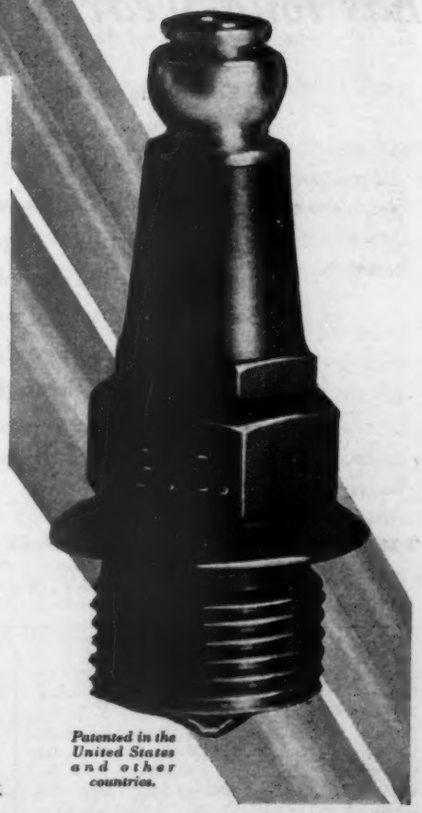


Captain Hawks in his Travel Air "Texaco 13" equipped with B. G. Mica Aviation Spark Plugs.

AFTER making America gasp at his feats of speed, Captain Frank M. Hawks has literally taken Europe's breath away by the records he has been making "over there."

In his Travel Air, "Texaco 13" he has flown from Paris to London in less than one hour; from Paris to Rome in three hours and thirty-one minutes—a record for the distance.

Captain Hawks is a record-breaker—not a stunt flyer. He is a safe and skillful pilot. He knows his plane and the vital importance of unfailing engine performance—that's why he uses B. G. Mica Aviation Spark Plugs.

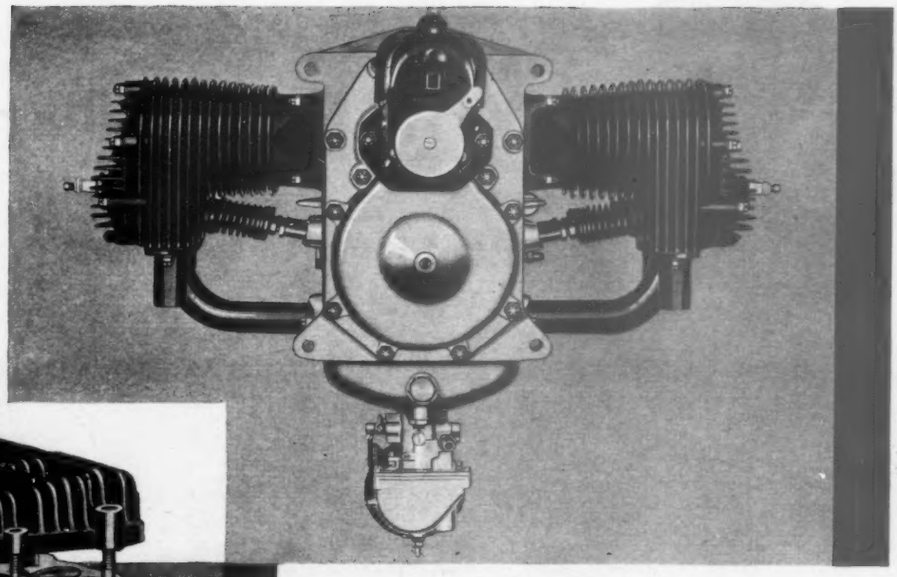


Patented in the United States and other countries.

THE B. G. CORPORATION

Contractors to the United States Army and Navy

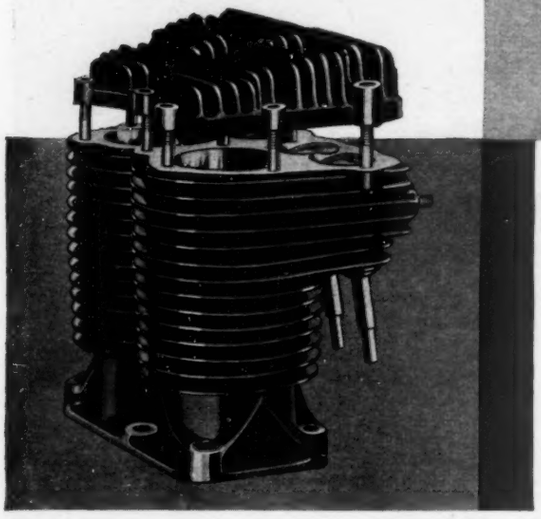
136 West 52nd St., New York **Cable Address: GOLSTECO, New York**



Right: *Continental A-40 aircraft engine, manufactured by Continental Aircraft Engine Co., Detroit, Mich.*

●

Below: *Nickel Cast Iron cylinders used on Continental A-40 aircraft engines cast by Gale Mfg. Co., Albion, Mich.*



Continental's new 4-cylinder airplane engine has long-wearing NICKEL CAST IRON *cylinders*

● **Following extensive tests in one of the world's most complete aircraft laboratories, Nickel Cast Iron cylinders have been selected for the new 4-cylinder Continental airplane engine.** ● **Nickel Cast Iron, called "the longest wearing cylinder material known today", is standard for cylinders in approximately 16 American airplane engines. By adding up to 3% Nickel to a proper base mixture, high strength and exceptional wear-resistance are consistently obtained in cylinder castings. Moreover, light section cooling fins are grey and consequently tough throughout.** ● **Without question, Nickel Cast Iron "performs better longer". That's why airplane engine builders and other important manufacturers specify it for quality products.**

Nickel CAST IRON
A BETTER MATERIAL FOR MODERN NEEDS

THE INTERNATIONAL NICKEL COMPANY, INC.
Miners, refiners and rollers of Nickel... Sole producers of Monel Metal
67 Wall Street, New York, N. Y.

Our casting specialists will gladly discuss your problems with you.

INCO NICKEL

DISTRIBUTORS

United States

ATLANTA.....J. M. Tull Rubber & Supply Co.
BOSTON, Whitehead Metal Products Co. of N. Y., Inc.
BUFFALO, Whitehead Metal Products Co. of N. Y., Inc.
CHICAGO.....Steel Sales Corp.
CINCINNATI.....Williams and Co., Inc.
CLEVELAND.....Williams and Co., Inc.
DENVER.....Hendrie & Bolthoff Mfg. & Supply Co.
DETROIT.....Steel Sales Corp.
ERIE.....Williams and Co., Inc.
KANSAS CITY.....Steel Sales Corp.
LOS ANGELES.....Pacific Metals Co., Ltd.
MILWAUKEE.....Steel Sales Corp.
MINNEAPOLIS.....Steel Sales Corp.
NEWARK, Whitehead Metal Products Co. of N. Y., Inc.
NEW ORLEANS.....Equitable Equipment Co., Inc.
NEW YORK, Whitehead Metal Products Co. of N. Y., Inc.
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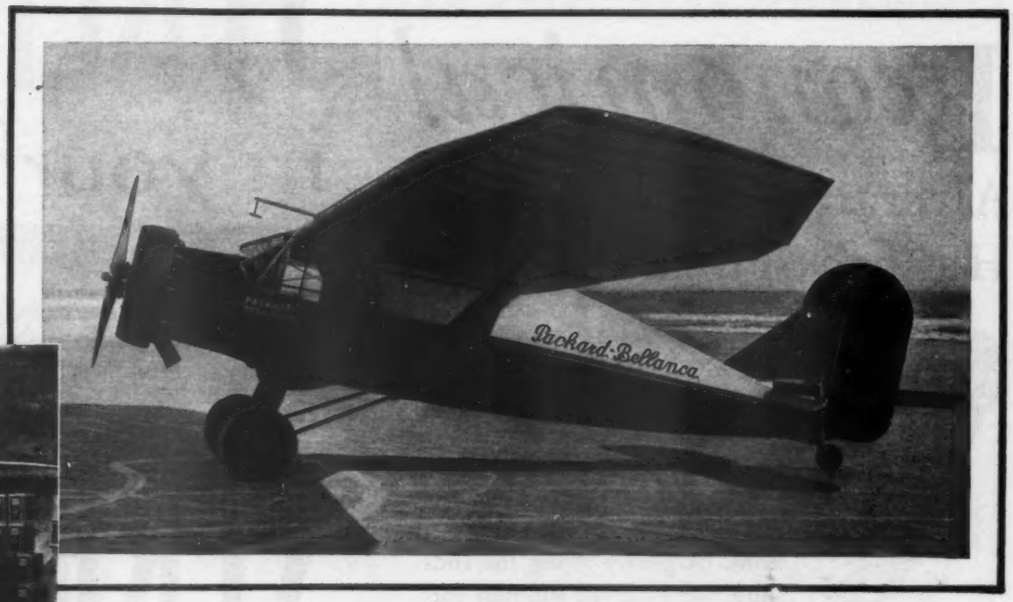
New non-refueling WORLD'S DURATION RECORD



Walter Lees, pilot (right) and Frederic A. Brossy, co-pilot, checking part of the fuel load before taking off in the Packard-Diesel Bellanca.

Established by PACKARD-DIESEL

AFTER flying continuously for more than three days and nights, a Packard-Diesel powered Bellanca at Jacksonville, Fla., May 28th, set a new non-refueling world's duration record of 84 hours and 33 minutes.

On May 25th the ship took off with a gross load of 6,715 pounds, including 481 gallons of fuel oil. When the wheels again touched the sands of the beach, the record established by the Frenchmen Bossoutrot and Rossi, in a specially constructed plane powered by a 600 H. P. gasoline engine, had been exceeded by 9 hours and 10 minutes!

This flight marked the successful culmination of Packard's efforts to recapture the significant world's non-refueling record for the United States. In April an attempt was frustrated by a "line squall" which blotted out all visibility and made an immediate landing imperative. However, not before the American record had been exceeded by 14 hours and 29 minutes —with the world's record only one hour and 35 minutes away.

It is significant to note that the 225 H. P. Packard-Diesel used on the record-breaking flight was the identical one employed on the previous attempt.

The achievement of the world's non-refueling duration record furnishes dramatic proof that for economy and reliability the Packard-Diesel Aircraft Engine is unmatched today! Private owners and commercial operators are invited to write for performance data on the Packard-Diesel.

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DETROIT, MICHIGAN

ASK THE MAN WHO OWNS ONE

Quicker
and more
Economical
Aircraft Assembly with Hartshorn Tie Rods

SQUARE SECTION TIE RODS can be adjusted with the wrench applied at any point along the rod. Tight corners are no longer troublesome. The flat faces permit making rods fast at intersections. A glance along the rods shows up even the slightest torsional strain, so there's no danger of twisted, weakened rods.

STREAMLINE TIE RODS are light and strong. They offer little resistance to the wind, thereby increasing speed and reducing fuel consumption.

Brace every ship you build or fly with

Hartshorn Est. 1860

AIRCRAFT TIE RODS

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250 Fifth Avenue New York, N. Y.

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in your Tubing
means
STRENGTH
in your Airplane

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8 TIMES AROUND THE WORLD!

Cessna Aircraft Company
ENCLOSED CANTILEVER MONOPLANES
WICHITA, KANS

April 27th. 1931

The Warner Aircraft Corporation,
20268 Hoover
Detroit, Michigan.

Gentlemen:

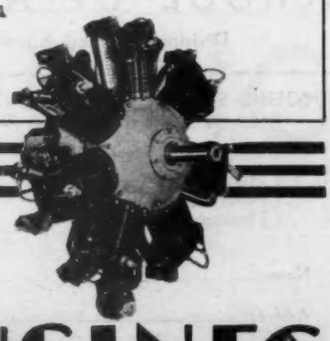
It is with very great pleasure that I tell you of the wonderful service we are getting from your old No. 26 which is one of the first ENGINES put out by you. We purchased this Engine as you know in 1928 and it has been back and forth across the United States a number of times in Races and on business. On one occasion, you will remember, it was flown by Parker Cramer into Fairbanks and Nome, Alaska; then across the Straits into Siberia and return to New York City.

In all of these 2500 hours or more of flying we do not know of one single part of this motor which has been broken. Nor has there been a single forced landing to my knowledge in all this flying which constitutes over EIGHT TIMES THE DISTANCE AROUND THE WORLD AT IT'S EQUATOR. I believe this is a record that you should know about.

I am confident that with one or two overhauls this motor will repeat this service.

Four of us just flew it to Detroit during the Aircraft Show in eight hours and twenty minutes cruising at 1700 and it is still going strong. I hope you build many more of these SPLENDID ENGINES.

Yours very truly,
C. V. Cessna
CLYDE V. CESSNA



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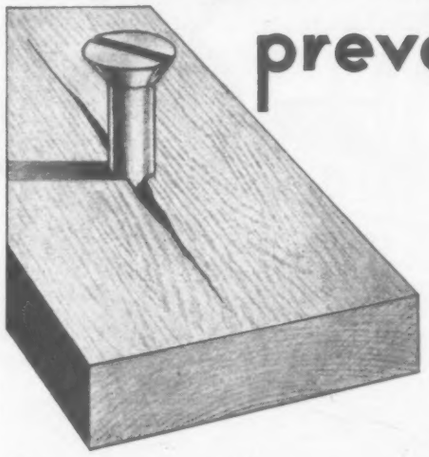

You can do any job better with

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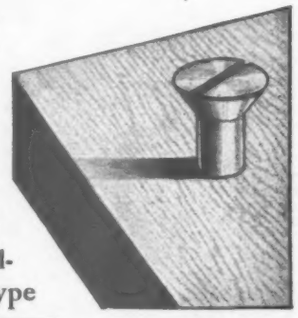

THE first thing to consider when selecting screws is their known quality and the second, the type of screw you need for your particular job.

American Screws have sharp gimlet points, true-running threads and slots which stand the strain. They are sold everywhere in a variety to meet all needs.

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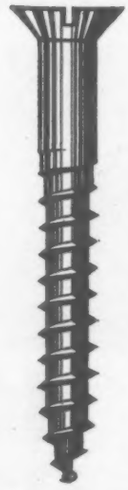

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"Put It Together With Screws"

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Above—A 1919 Boeing Flying Boat which was flown 500,000 miles before being retired from regular service.

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NO plane has equalled the service record of the 12-year-old Boeing Flying Boat that has worn out nine engines and flown a half million miles. For nine years it flew over open seas on the Seattle-Victoria air mail route, first U. S. contract air mail service.

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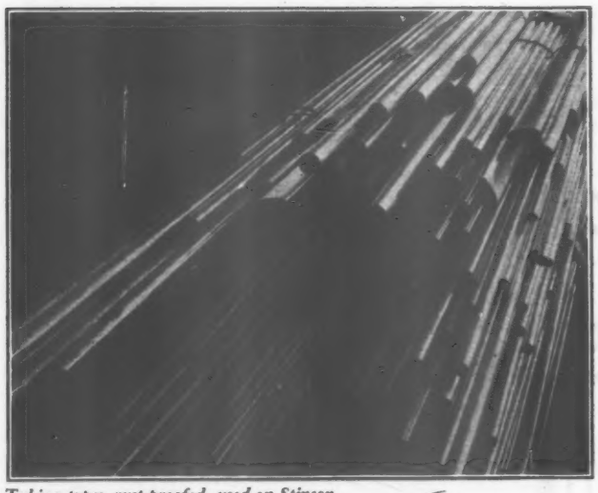

Tubing types, rust-proofed, used on Stinson planes. Photograph by courtesy Stinson Aircraft Corp. and World's Work.

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SATISFACTORY PERFORMANCE *in actual service* breeds confidence in the quality of any product—and in the integrity of its maker!

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In the same way that we supply the automotive industry, we now furnish leading airplane manufacturers with the special alloy steel tubing their particular requirements demand.

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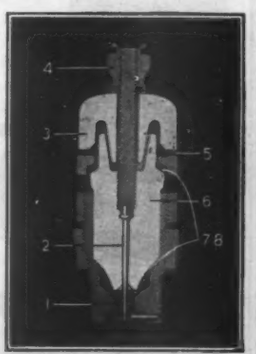

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Hereafter, Parks students will obtain flight instruction with enclosed cabin comfort, in the WACO "Model C" which Oliver L. Parks describes as "the neatest performer I've found; so good that Parks students must have it" . . . for such ease of control, unobstructed visibility, unprecedented aptitude for quick take-offs and short landings have never before been associated with any cabin airplane . . . and especially one adapted to the limitation of fledging flyers! ● Isn't all this significant to you, too? Moreover, your use of an airplane will scarcely be restricted to short hops in close proximity to complete airport facilities. The more reason why your choice should be a WACO! For then, wherever you set down, WACO service is at your beck and call. This service factor is an item that doesn't appear in WACO specifications. But don't overlook it in making your selection . . . whether your need be for 110 or 300 H. P. . . . for an open-cockpit or a cabin WACO.

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The complete WACO line ranges from $4450 to $8525 with Heywood starters standard equipment on all models.

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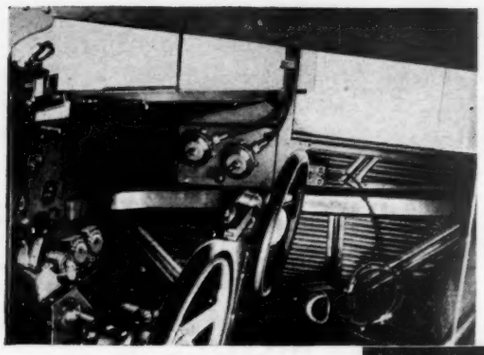
S.S.WHITE Flexible Shafts contribute to reliability of *Western Electric* Radio Receivers . . . . . .



In this W. E. airplane installation S. S. WHITE Flexible Shafts accurately and reliably transmit the finest movements of the control handles to the high and low frequency receivers mounted in the fuselage.

WESTERN ELECTRIC RADIO has made a notable contribution to the progress of air transportation by providing a sure and dependable means of signalling and communication between planes and ground stations.

The excellence of W. E. Radio Equipment is amply proved by the fact that many of the leading air transport lines of the country are W. E. equipped.

It is significant of the quality and reliability of S. S. WHITE Flexible shafts that they are used as the medium of remote control in WESTERN ELECTRIC Receivers.

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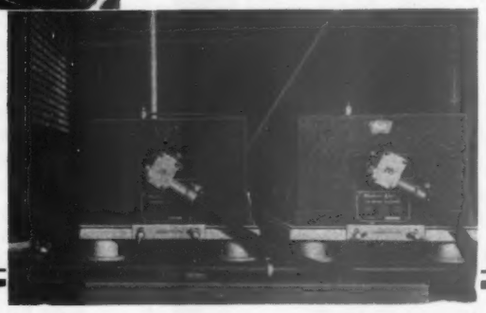

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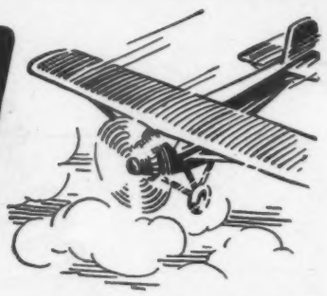

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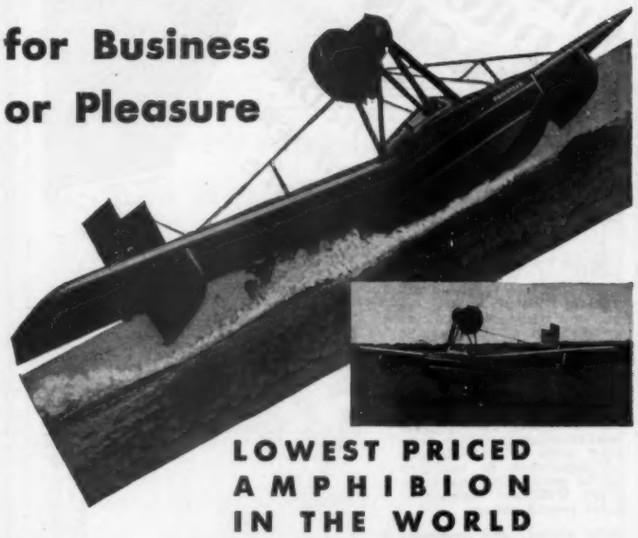

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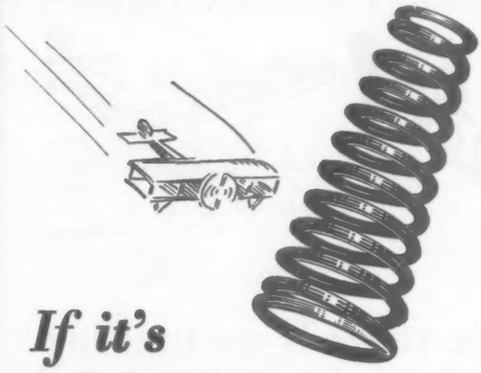

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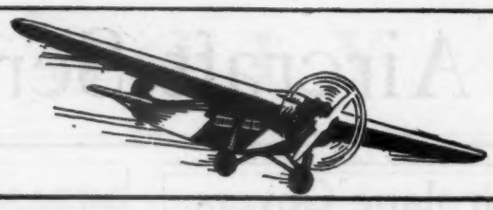

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of this issue covers the current business wants of the industries in which this paper is read.

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1 to 50 yds. 43c.—50 to 100 yds. 38c.
Dope, 1 gal. $2.00, 5 gal. $1.75 gal., 50 gal. $1.50.
Rib Cord, $1.00 Spool; Needles, 25c. each.
2¼-in. Pinked Tape, 3c. per yd.

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$5,000.00 Stock of New and Used Parts for Wright Whirlwind J-4, J-5, J-6, and Warner Scarab Motors, consisting of:

New and Used Valves, Cylinders, Crank Shafts, Rocker Arm Assemblies, Master Rods, Articulating Rods, Crank Cases, Carburetors, Scintilla Magnetos, Pistons, Wrist Pins, Cam Gears, Cam Shafts, Propeller Hubs, in fact, any and all kinds of parts for the above mentioned motors.

Might consider taking a good airplane in on one of these motors. Write or Wire

MICHIGAN AERO MOTORS, Jackson, Michigan

For sale by manufacturer:

5-place, Twin Engined Cabin Monoplane

The Ideal Ship for Executives whose time and lives are valuable, Powered with 2 Wright J-6 300 HP. Engines, High Speed 152 MPH., Initial Climb 1500 FPM., Ceiling with One Engine 9000 feet. License NC-493M.

Complete Specifications and Price on Request

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Flying Equipment—At Bargain Prices

GOGGLES, Luxor No. 8 Non-shatterable	Regular Price,	$32.00—OUR PRICE,	$18.00
GOGGLES, Luxor No. 8 Army Type	Regular Price,	18.00—OUR PRICE,	9.00
GOGGLES, Luxor No. 7 or 8 Navy Type	Regular Price,	18.00—OUR PRICE,	9.00
GOGGLES, Luxor No. 7 or 8 Euphos or Amber	Regular Price,	19.50—OUR PRICE,	9.75
GOGGLES, Luxor No. 7 Non-shatterable	Regular Price,	30.00—OUR PRICE,	16.00
GOGGLES, Luxor No. 7 Cylindrical lenses	Regular Price,	13.75—OUR PRICE,	7.00
GOGGLES, Dictator, Curved lenses	Regular Price,	5.00—OUR PRICE,	2.50
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LEATHER JACKETS, Black, blanket lined, zipper fasteners	Regular Price,	15.00—OUR PRICE,	7.50
FLYING COATS, Black horse hide, blanket or sheep lined	Regular Price,	16.00 to 24.75—OUR PRICE,	8.00
LEATHER WINDBREAKERS, Snap fasteners, knitted wrist bands	Regular Price,	12.00—OUR PRICE,	5.50
JOHNSON SPEAKING TUBES, complete One-way	Regular Price,	9.00—OUR PRICE,	7.00
Two-way	Regular Price,	18.00—OUR PRICE,	13.00
PYRENE FIRE EXTINGUISHER, Brand new Quart size	Regular Price,	12.00—OUR PRICE,	6.00
Pint size	Regular Price,	9.00—OUR PRICE,	4.50
FLASH FIRE EXTINGUISHER, Brand new Quart size	Regular Price,	8.25—OUR PRICE,	4.00
Pint size	Regular Price,	5.00—OUR PRICE,	2.50
FIRST AID KITS, Bauer & Black No. 50	Regular Price,	1.00—OUR PRICE,	.75
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These prices are net cash or 50% with order, balance C.O.D. Subject to prior sale.

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J-5s, J-6s, J-4s, Whirlwinds, Warner Scarabs, 110 hp., LeBlond 60 hp., Anzani 110 hp., OX5s, Hispano Suizas. Write for descriptions and prices.

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New 26x5 Drop Center, replacement wheels and tires, $38 per set.
New 30x5 Drop Center brake wheels and tires $49 per set.

Send for circulars.

FOR SALE

Six Place STINSON Monoplane

Wright J5 Motor. Ship, motor, paint and fabric all like new. Never been cracked up or misused. Used only 200 hours. Will sacrifice to dissolve partnership—$2250.00.

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1—Used Mono Coupe, new type landing gear, perfect condition, $850.
1—Brand new Mono Coupe, 65 Velie, $1,650.
1—Barling NB3 with 60 Le Blond, $1,000.
1—Cardinal Coupe, like new, $1,500.
1—Mono Coupe, used very little, $750.
1—Brand new Heath, $550.
1—Brand new Stinson Junior, $4,995.
1—Used Stinson Junior, $3,500.

Tuxhorn Flying School, Inc.
Municipal Field, Kansas City, Mo.

FOR SALE

1—Challenger Speedwing Travel Air $2200.
1—Waco Warner F. Like new. $3500.
1—Waco-F with 70 hours, Warner motor. $3300.
1—Waco-90. $1300.
1—Challenger OX $1200.

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WHERE TO FLY

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A Warner 7 cylinder —Scintilla-equipped.

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The Warner Aircraft Corporation uses Scintilla Aircraft Magnetos. They write: "We have experienced no trouble with them; some of our Scintilla-equipped engines having had as many as 2000 hours flying time." Thus has Scintilla done its job unfailingly for Warner, as it has for practically all leading aircraft engines. Dependable performance always—you can be sure of that.

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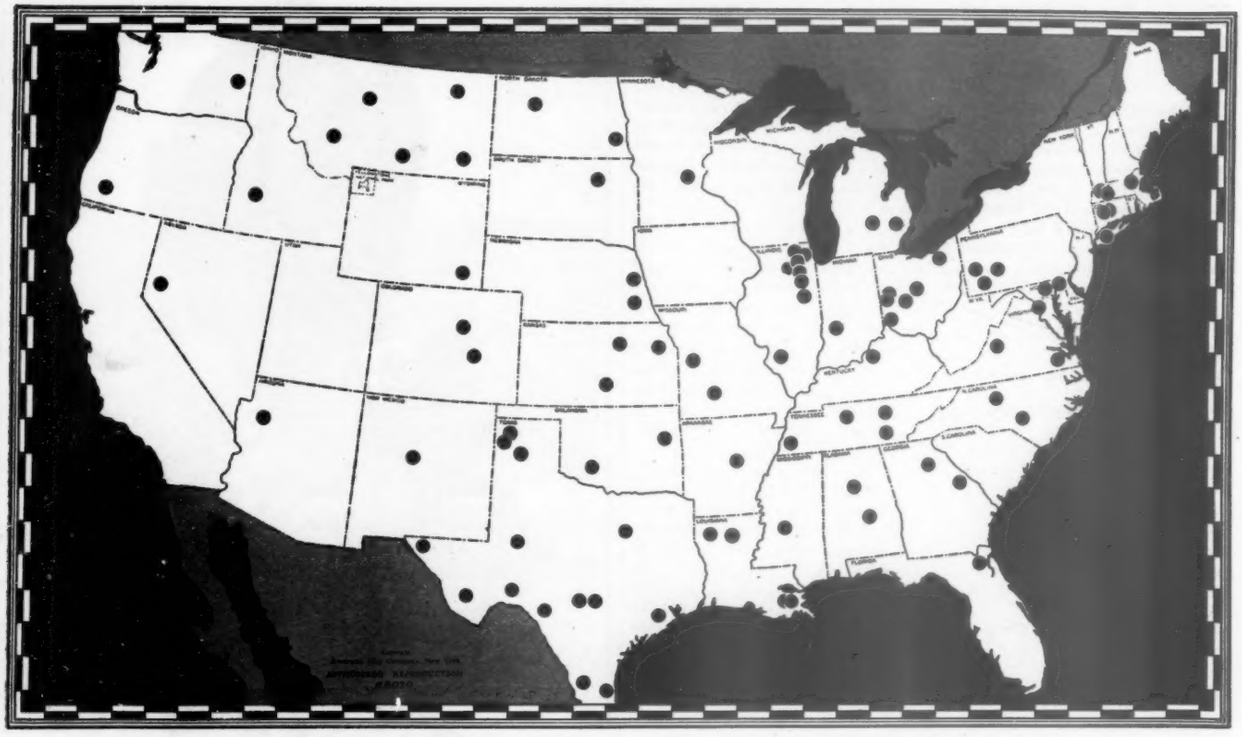
AERONAUTICAL CHAMBER OF COMMERCE

(Subsidiary of Bendix Aviation Corporation)

SERVICE *and* DISTRIBUTION for the Air Corps Maneuvers



In the carefully coordinated plan of the Air Corps, which made its recent air spectacle possible, one of the chief problems was that of arranging fuel and oil supplies. These had to be of highest quality. They had to be available, in varying quantities, from coast to coast, at each of the airports visited. Adequate facilities for rapid servicing of large numbers of planes were needed at each field.

The following approximate figures outline the service record of Stanavo distributors:

Supplied products to 92 fields (95% of fields visited)
Supplied three-quarters of a million gallons of Stanavo Aviation Gasoline with Ethyl (87 octane number) (72% of the gasoline used)
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Made available 650 men and 300 tank trucks for the actual servicing.

When you consider the purchase of oil and gasoline, consider also the proven record of Stanavo, not only in military planes, but also in the operation of leading commercial lines, the world over. You can rely anywhere and everywhere on the quality of the products developed by the organization which believes *"the best is none too good for Aviation."*

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STANDARD OIL COMPANY (INDIANA)
910 S. Michigan Avenue, Chicago

STANDARD OIL CO. OF NEW JERSEY
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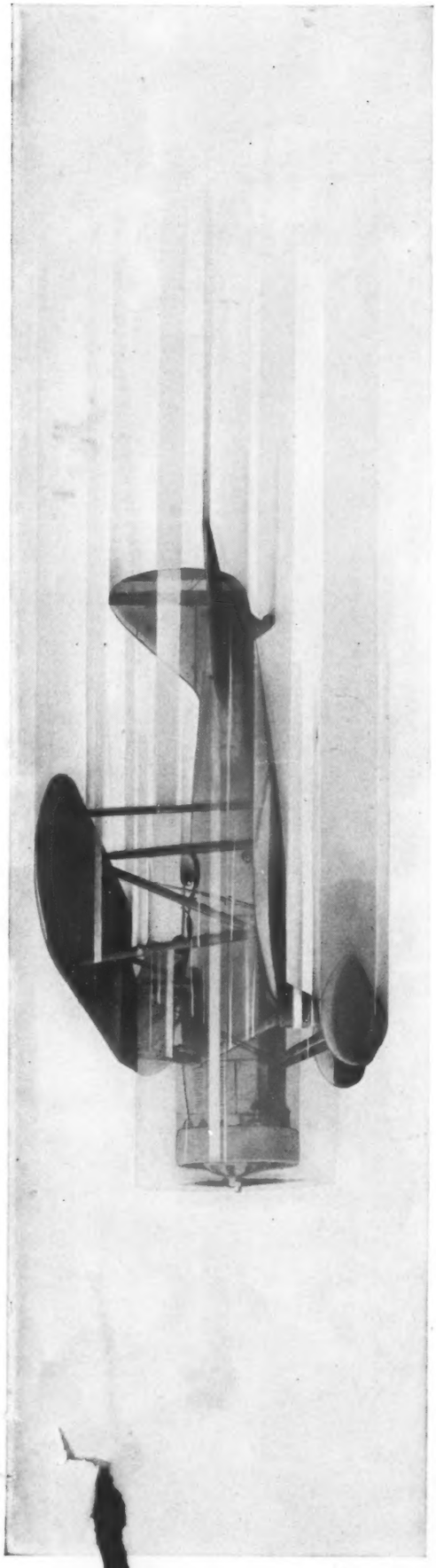

Navy Approves *New* Diving Bomber

VERTICAL DIVES from great heights—Immelmans—loops—inverted flying—with a 1000 lb. bomb load! This astounding performance of the New Martin Diving Bomber caused Navy Officials a year ago to acclaim a new era in aerial tactics.

Now, after a year's rigorous testing, comes an order from the Navy for two squadrons of these sturdy bombers, proving conclusively the success of this phenomenal plane.

Again, the Martin Company has demonstrated the dependability of its engineering methods—its unsurpassed capacity for producing quality aircraft in quantity at low cost.

The Glenn L. Martin Co.

Builders of Dependable Aircraft Since 1909

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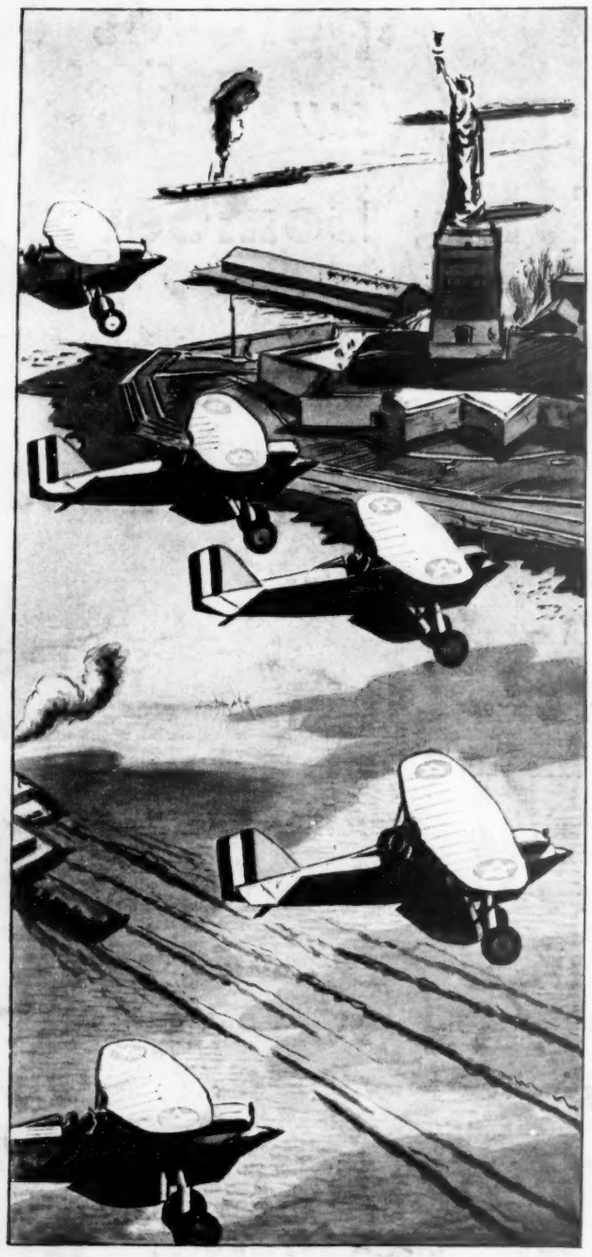

THE thundering herd of 672 Army planes has shown how dependable is airplane travel when piloted by able men and powered by capable motors. They flew thousands upon thousands of miles in the Eastern manoeuvers and won a perfect score for safety and for efficiency!

Weather wasn't always favorable. Routes were tortuous at times. Take-offs and landings had to be made on all kinds of fields. A total of 3,200,000 miles were flown. Yet this great armada flew from State to State in tight formation and ended the manoeuvers without a single accident! The Army is proud of this. So is Wright. For in this big parade were 258 engines that they built.

But dramatic though this display of Wright's leadership is, it doesn't out-do the quiet demonstration that is constantly being made by Wright engines here and abroad. In fact 42% of all engines powering commercial planes in this country on January 1st of this year were made by Wright . . . a proportion far in advance of the nearest competitor.

Captain Hawks is showing Europe what the "Whirlwind 300" can do in smashing the major cross-country records over there. And Dornier made a significant move when he came to Wright for 12 Conqueror engines to power the 150-passenger DO-X.

WRIGHT

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PATERSON, NEW JERSEY
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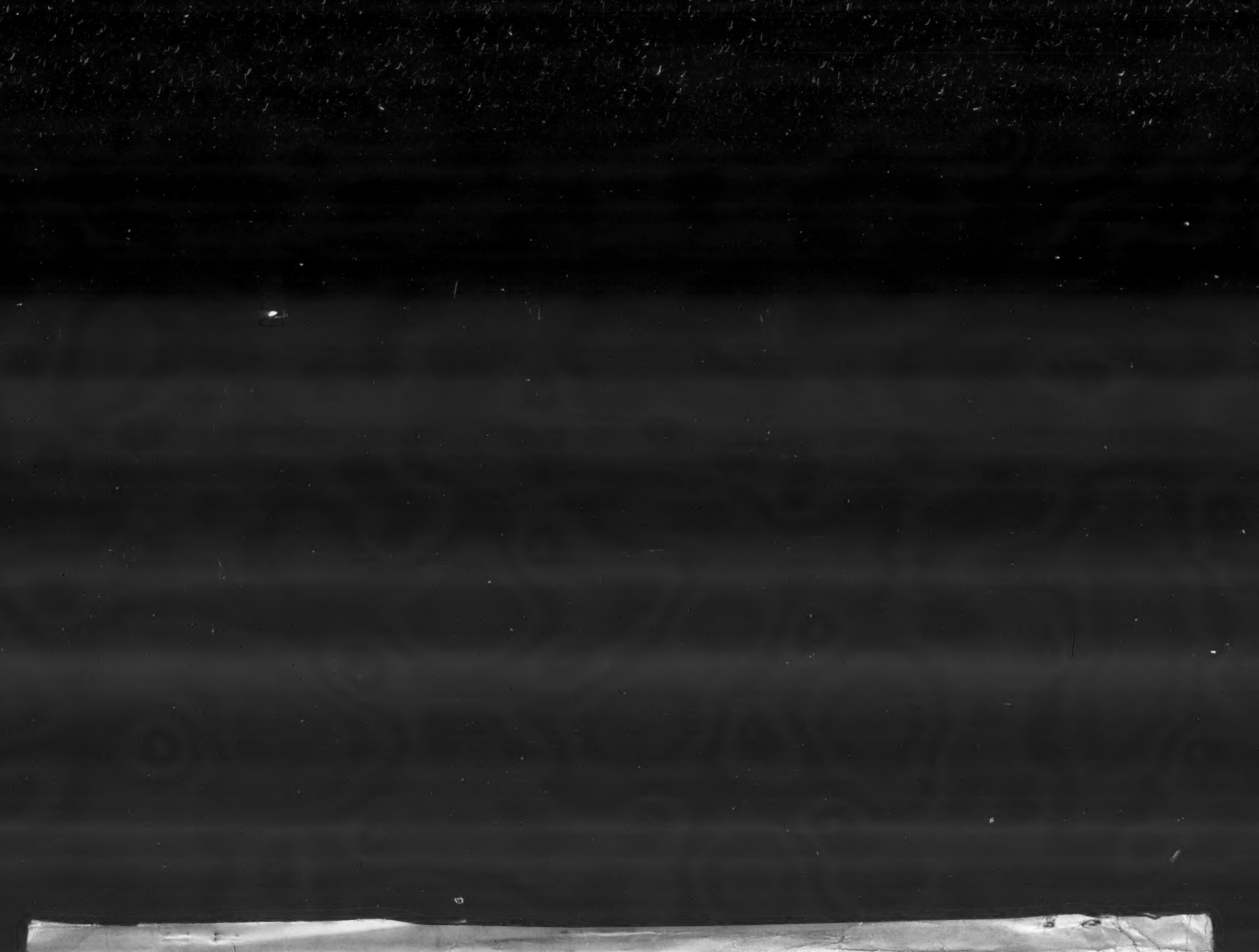
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